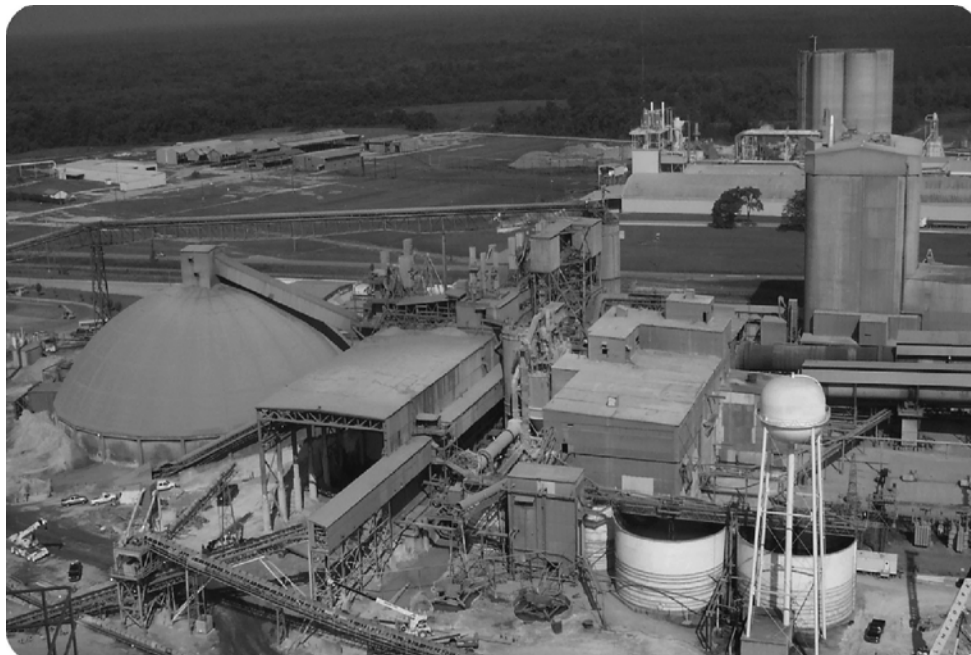


PowerFlex® 7000 Medium Voltage AC Drive Air-Cooled ("B" Frame)—ForGe Control

Publication 7000-IN007E-EN-P



Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.



SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.



ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

This manual contains new and updated information.

New and Updated Information

This table contains the changes made to this revision.

Topic	Page
Replace "Tachometer" with "Encoder"	Throughout
Added HPTC information to Topology section	11
Updated "When is an Encoder Required?" section and table	74
Replaced Encoder Selection table	75
Added HPTC information to Drive Torque Capabilities table	76
Updated Typical Application Load Torque Profiles	77
Updated Speed Regulator Bandwidth	92
Updated Torque Regulator Bandwidth	92
Inserted Torque Accuracy with HPTC	92
Added Polish to list of available Languages	93
Added "Dual-port Ethernet/IP" to Communications Protocols	94

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Important User Information

This document provides procedural information for installing the PowerFlex 7000 medium voltage “B” Frame drives (heat sink and heat pipe models). This document also includes specific information regarding customer responsibilities prior to commissioning.

Who Should Use This Manual

This manual is intended for use by personnel familiar with medium voltage and solid-state variable speed drive equipment. The manual contains material that enables qualified engineering personnel to install the drive system.

What Is Not in this Manual

This manual provides information specific to installing and configuring the PowerFlex 7000 “B” Frame drive. The following topics are covered in other manuals in the next paragraph:

- Physically transporting or siting the drive cabinetry
- Commissioning-specific processes and configuration, as managed by a Rockwell Automation commissioning engineer
- Details concerning the operator interface, or configuring drive parameters
- Dimensional and electrical drawings generated for each customer’s order
- Spare parts lists compiled for each customer’s order
- Troubleshooting potential usage problems

Refer to the following documents for additional product detail or instruction relating to PowerFlex 7000 “B” Frame drives:

- Drive-specific Technical Specifications
- Transportation and Handling Procedures: receiving and handling instructions for Medium Voltage variable frequency drive and related equipment
- Installation Guide: detailed installation and pre-commissioning procedures and information
- Commissioning Guide: required procedures and checklists for Rockwell Automation field service engineers
- Drive-specific User Manual: instructions for daily and recurring drive usage or maintenance tasks
- Drive-specific Technical Data: additional troubleshooting, parameters, and specification information for MV variable frequency drives

Rockwell Automation provides the site- and installation-specific electrical and design information for each drive during the order process cycle. If they are not available on-site with the drive, contact Rockwell Automation.

If you have multiple drive types or power ranges, ensure you have the correct documentation for each specific PowerFlex 7000 product:

- “A” Frame for lower power air-cooled configurations (up to approximately 1250 hp / 933 kW)
- “B” Frame for higher-power, air-cooled configurations (heat sink or heat pipe models)
- “C” Frame for all liquid-cooled configurations

Manual Conventions

This manual uses a variety of symbols to indicate specific types of information.



WARNING: Warnings indicate where people may be hurt if users do not follow procedures properly.



ATTENTION: Cautions indicate where machinery damage or economic loss may occur if users do not follow procedures properly.

Both of the above symbols could indicate:

- A possible trouble spot
- Tell what causes the trouble spot
- Give the result of an improper action



SHOCK HAZARD: This symbol indicates a potential electrical shock hazard on a component or printed circuit board

General Precautions



ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.



ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.



ATTENTION: Only personnel familiar with the PowerFlex 7000 Adjustable Speed Drive (ASD) and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

Commissioning Support

After installation, Rockwell Automation Medium Voltage Support is responsible for commissioning support and activities in the PowerFlex 7000 product line.

Phone: 519-740-4790

Option 1 for technical and option 4 for commissioning questions

MVSupport_technical@ra.rockwell.com or
MVSupport_services@ra.rockwell.com

Rockwell Automation support includes, but is not limited to:

- quoting and managing product on-site start-ups
- quoting and managing field modification projects
- quoting and managing customer in-house and on-site product training

Notes:

PowerFlex 7000 Overview

The PowerFlex 7000 is a general purpose, stand-alone, medium voltage drive that controls speed, torque, direction, starting and stopping of standard asynchronous or synchronous AC motors. It works on numerous standard and specialty applications such as fans, pumps, compressors, mixers, conveyors, kilns, fan-pumps, and test stands in industries such as petrochemical, cement, mining and metals, forest products, power generation, and water/waste water.

The PowerFlex 7000 meets most common standards from the National Electrical Code (NEC), International Electrotechnical Commission (IEC), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Canadian Standards Association (CSA). It is available with the world's most common supply voltages at medium voltage, from 2400...6600V.

The design focus is on high reliability, ease of use, and lower total cost of ownership.

Topology

The PowerFlex 7000 uses a Pulse Width Modulated (PWM) – Current Source Inverter (CSI) for the machine side converter as shown in [Figure 6](#). This topology applies to a wide voltage and power range. The power semiconductor switches used are easy-to-series for any medium voltage level. Semiconductor fuses are not required for the power structure due to the current limiting DC link inductor.

With 6500V PIV rated power semiconductor devices, the number of inverter components is minimal. For example, only six inverter switching devices are required at 2400V, 12 at 3300...4160V, and 18 at 6600V.

The PowerFlex 7000 also provides inherent regenerative braking for applications where the load is overhauling the motor (e.g. downhill conveyors, etc.), or where high inertia loads (e.g. fans, etc.) are quickly slowed down. The drive uses Symmetrical Gate Commutated Thyristors (SGCTs) for machine converter switches, and Silicon-controlled Rectifiers (SCRs) (for 18 Pulse rectifier configurations) or SGCTs (for Active Front-end [AFE] rectifier configurations) for the line converter switches.

The PowerFlex 7000 provides a selectable option for enhanced torque control capabilities and increased dynamic control performance. This High Performance Torque Control (HPTC) feature delivers 100% torque at zero speed and provides torque control through zero speed with smooth direction transition.

Rectifier Designs

Configurations

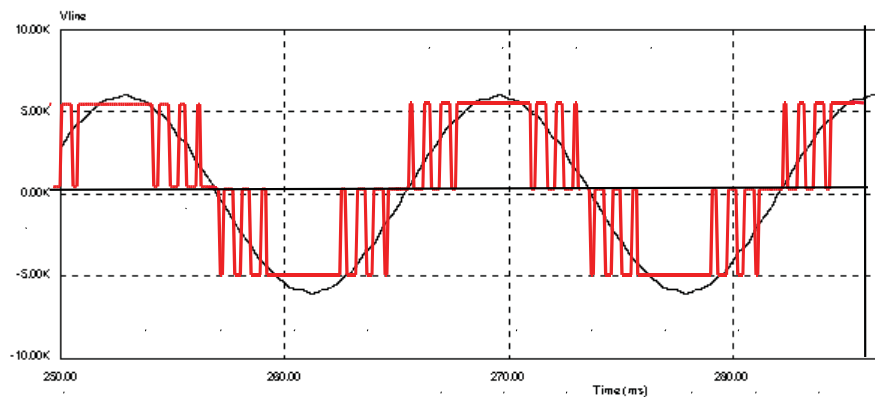
The PowerFlex 7000 offers three rectifier configurations for "B" Frame drives:

- Direct-to-Drive (Active Front End [AFE] rectifier with integral line reactor and Common Mode Choke)
- AFE rectifier with separate isolation transformer
- 18 Pulse with separate isolation transformer

Direct-to-Drive

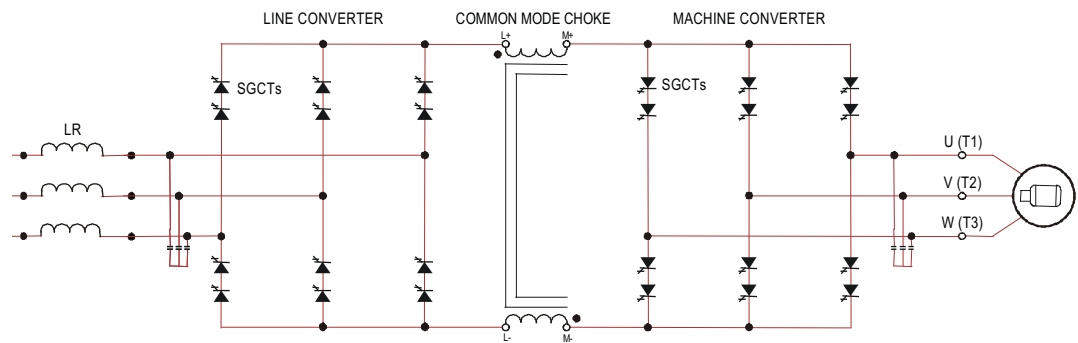
Direct-to-Drive™ technology does not require an isolation transformer or multiple rectifier bridges as in Voltage Source Inverter (VSI) topologies offered by others. The approach is completely different. Instead of multiple uncontrolled rectifiers, a single AFE rectifier bridge is supplied. The rectifier semiconductors used are Symmetrical Gate Commutated Thyristors (SGCTs). Unlike the diodes used in VSI rectifier bridges, SGCTs are turned on and off by a gating signal. A Pulse Width Modulation (PWM) gating algorithm controls the firing of the rectifier devices, very similar to the control philosophy of the inverter. The gating algorithm uses a specific 42 pulse switching pattern ([Figure 1](#)) called Selective Harmonic Elimination (SHE) to mitigate the 5th, 7th, and 11th harmonic orders.

Figure 1 - Typical PWM switching pattern , line voltage waveform

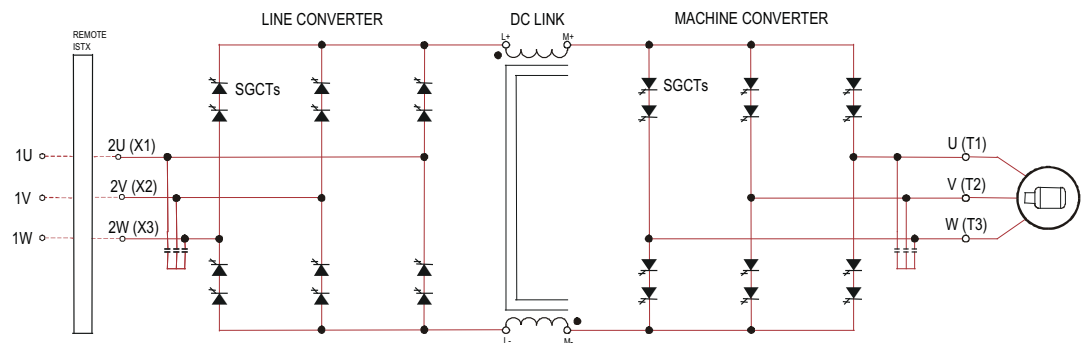


A small integral line reactor and capacitor addresses the high harmonic orders (13th and above) and provides virtually sinusoidal voltage and current waveforms back to the distribution system. This delivers excellent line-side harmonic and power factor performance to meet IEEE 519-1992 requirements and other global harmonic standards, while still providing a simple, robust power structure that maximizes uptime by minimizing the number of discrete components and the number of interconnections required.

A Common Mode Choke (CMC) mitigates the common mode voltage seen at the motor terminals, so standard (non-inverter duty rated) motors and motor cables can be used, making this technology ideal for retrofitting existing motor applications.

Figure 2 - 3300/4160V AFE Rectifier (Direct-to-Drive)*AFE Rectifier with Separate Isolation Transformer*

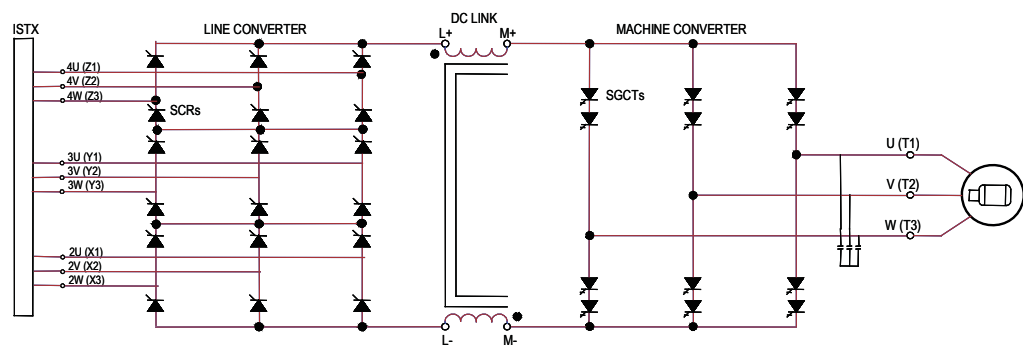
For applications when the line voltage is higher than the motor voltage, a transformer is required for voltage matching. In this case, providing an AFE rectifier with a separate isolation transformer is ideal. The isolation transformer provides the input impedance (replaces the requirement for an integral line reactor) and addresses the common mode voltage (replaces the requirement for a CMC that is supplied in the Direct-to-Drive rectifier configuration). However, the AFE rectifier, its operation, and advantages are the same as the Direct-to-Drive configuration.

Figure 3 - 3300/4160 AFE Rectifier with separate isolation transformer)

18 Pulse Rectifier with Separate Isolation Transformer

For high power, constant torque applications and/or when the line voltage is higher than the motor voltage, a transformer is required for voltage matching. The 18 Pulse rectifier uses SCRs instead of the SGCTs used for an AFE rectifier. When used for high power and constant torque applications, the 18 Pulse rectifier has lower losses than the AFE rectifier, making it ideal for the highest power requirements. The 18 Pulse isolation transformer provides the required input impedance and addresses common mode voltage just like the separate isolation transformer used with the AFE rectifier. However, instead of a PWM switching pattern and a single rectifier bridge, the 18 Pulse configuration mitigates line side harmonics through harmonic current cancellation in the isolation transformer phase shifted secondary windings. The inverter is the same configuration for all available rectifier options.

Figure 4 - 3300/4160V 18 Pulse rectifier



Cooling Technology

These VFDs are supplied with heat sinks for low and mid-power configurations and heat pipes for high-power configurations. While both configurations draw heat away from the semiconductors, heat pipes are bigger, more efficient, and require larger fans and airflow.

Information and graphics in this manual show both configurations.

Motor Compatibility

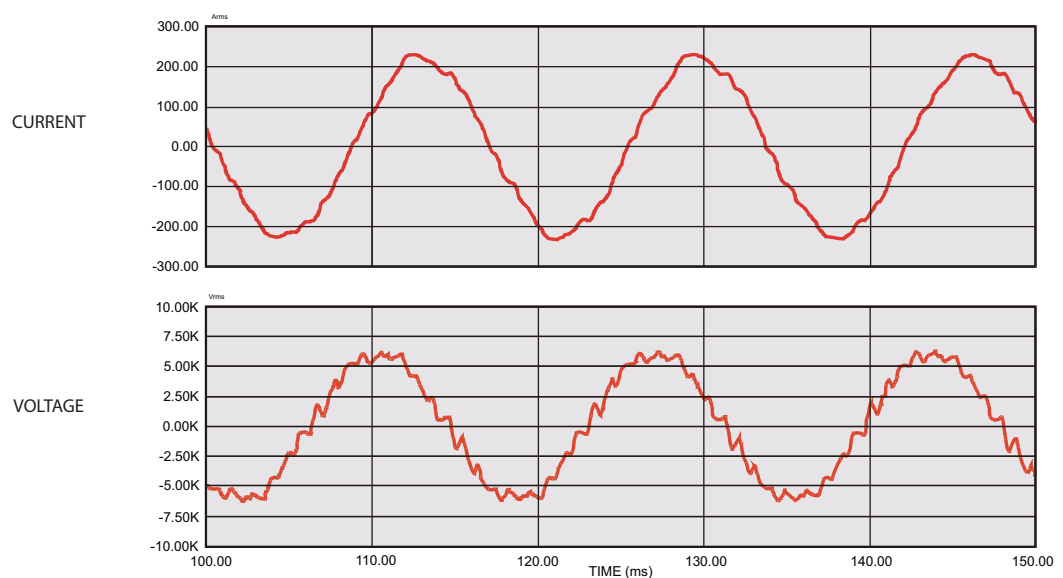
The PowerFlex 7000 achieves near-sinusoidal current and voltage waveforms to the motor, resulting in no significant additional heating or insulation stress. Temperature rise in the motor connected to the VFD is typically 3 °C (5.5 °F) higher compared to across-the-line operation. Voltage waveform has dv/dt of less than 10 V/ μ s. The peak voltage across the motor insulation is the rated motor RMS voltage divided by 0.707.

Reflected wave and dv/dt issues often associated with voltage source inverter (VSI) drives are a non-issue with the PowerFlex 7000. [Figure 5](#) shows typical motor waveforms. The drive uses a selective harmonic elimination (SHE) pattern in the inverter to eliminate major order harmonics, plus a small output capacitor (integral to the drive) to eliminate harmonics at higher speeds.

Standard motors are compatible without de-rating, even on retrofit applications.

Motor cable distance is virtually unlimited. Rockwell Automation has tested this technology for controlling motors up to 15 km (9.3 mi) away from the drive.

Figure 5 - Motor waveforms @ full load, full speed



Simplified Electrical Diagrams

2400V

Figure 6 - 2400V – AFE Rectifier, Configuration #1 – Direct-to-Drive

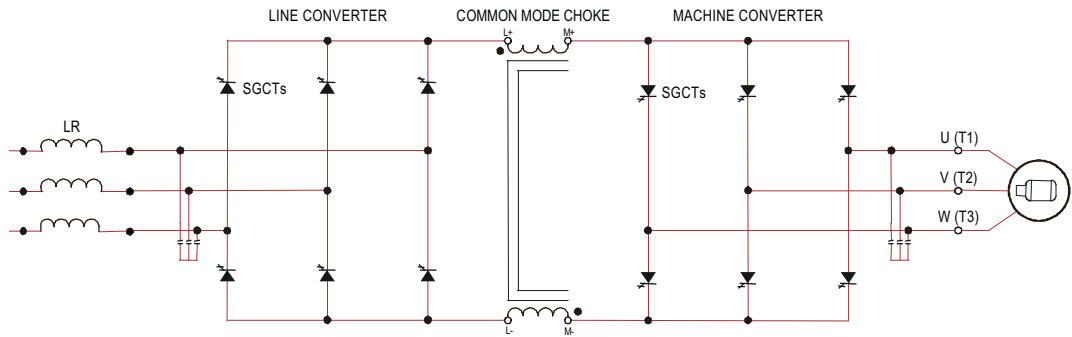


Figure 7 - 2400V – AFE Rectifier, Configuration #2 – Separate Isolation Transformer

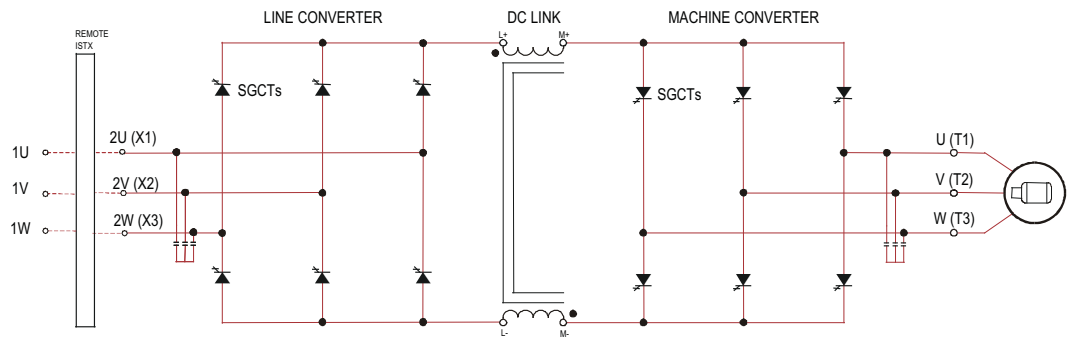
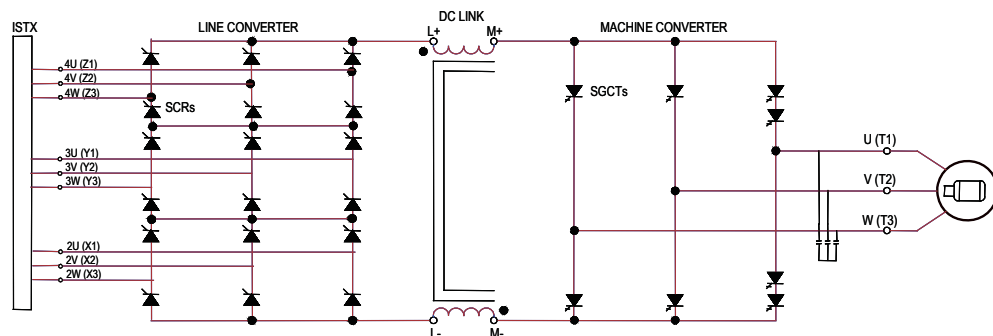
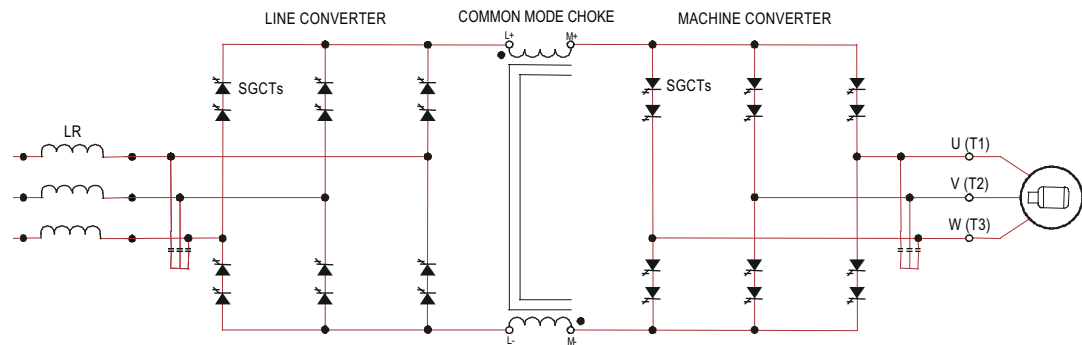
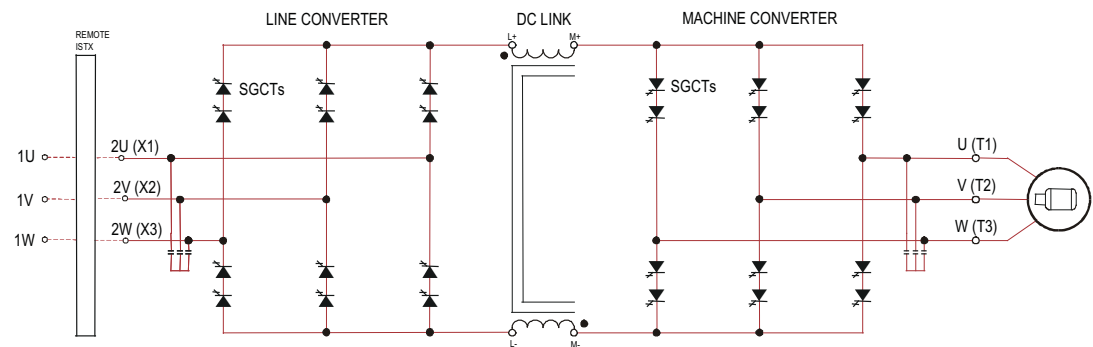
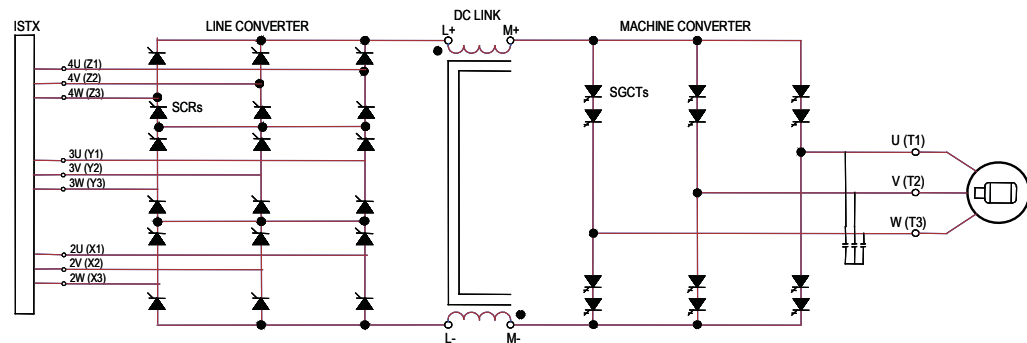


Figure 8 - 2400V - Configuration #3 - 18 Pulse



3300/4160V**Figure 9 - 3300/4160V – AFE Rectifier, Configuration #1 – Direct-to-Drive****Figure 10 - 3300/4160V – AFE Rectifier, Configuration #2 – Separate Isolation Transformer****Figure 11 - 3300/4160V - Configuration #3 - 18 Pulse**

6600V

Figure 12 - 6600V – AFE Rectifier, Configuration #1 – Direct-to-Drive

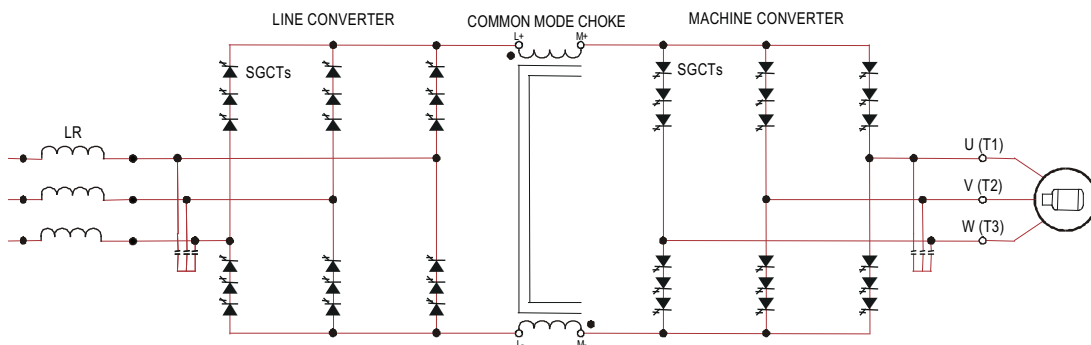


Figure 13 - 6600V – AFE Rectifier, Configuration #2 – Separate Isolation Transformer

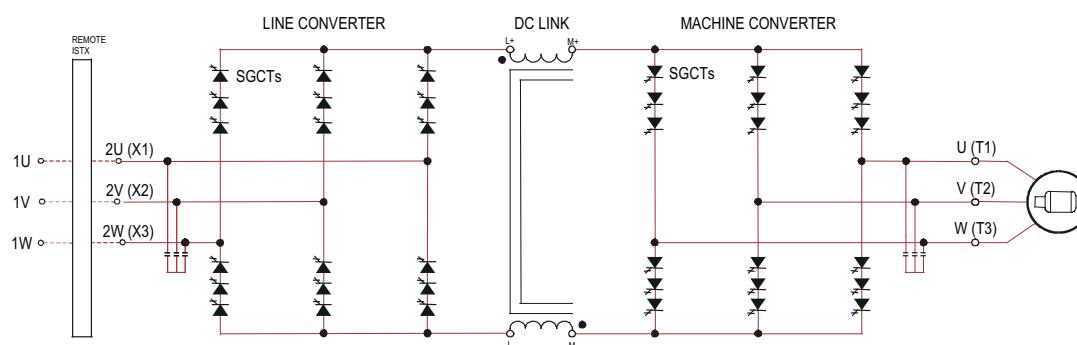
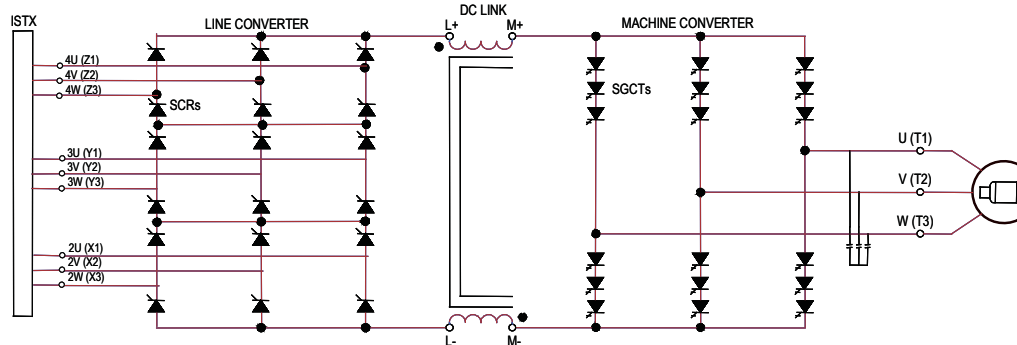


Figure 14 - 6600V - Configuration #3 - 18 Pulse



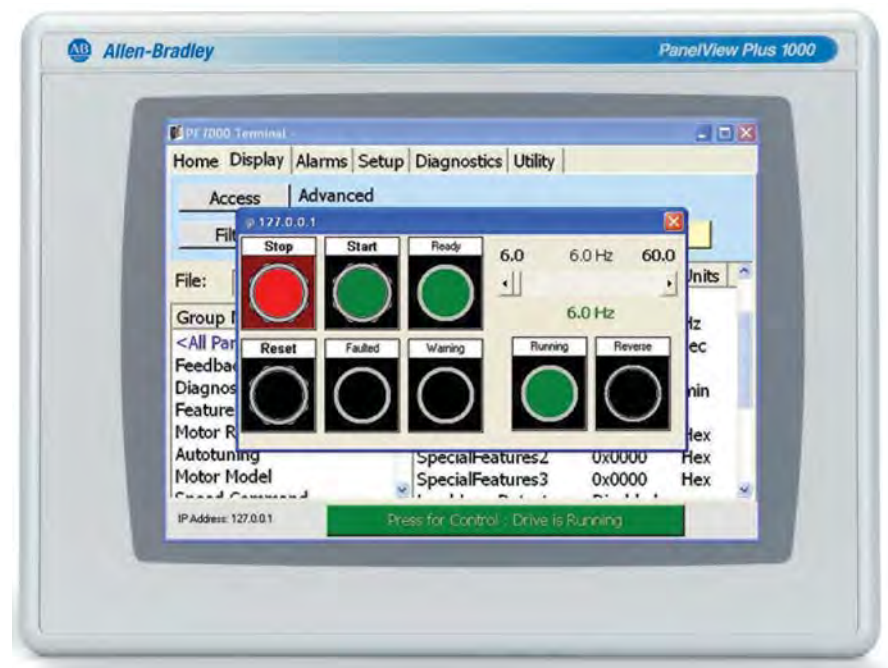
Operator Interface

The HMI Interface Board is an HMI-enabling device for the PowerFlex 7000 drive. It allows the user to acquire all the necessary executable tools, documentation and reports required to commission, troubleshoot and maintain the drive.

Via the HMI Interface Board, the user can choose the style and size of the desired Windows-based operator terminal to interact with the drive (e.g. PanelView CE terminal, laptop, or desktop computer). The HMI Interface Board removes past issues with compatibility between the drive and configuration tools, as all the necessary tools are acquired from the drive.

The HMI Interface Board is well suited for applications that require remote placement of the operator terminal and remote maintenance.

Figure 15 - Operator Interface



Basic Configurations

There are three basic configurations for the HMI Interface Board.

Remote-mounted HMI

The HMI is not mounted in the traditional location on the low voltage door of the Variable Frequency Drive (VFD). A remote mounting plate, complete with E-Stop push button, and HMI is supplied loose for the customer to mount wherever desired. The HMI connects to the VFD via a hardwired Ethernet cable. There is no functional distance limitation.

This is ideal for non-PLC users wanting to control and monitor remotely (e.g. at the driven machine, control room, etc.). Also ideal for customers having policies in place to control access to medium voltage equipment and the associated requirements of PPE when using the operator interface at the VFD, etc.

Locally-mounted HMI

Similar to the existing PanelView 550, the HMI is mounted on the LV door of the VFD. There is also a service access port (RJ-45 connector) on the LV door.

No HMI supplied

A service access port (RJ-45 connector) is located on the LV door of the VFD. Customers use their own laptop as the HMI. All programs required to use the laptop as the HMI are stored in the VFD. Their laptop is connected to the VFD via a hardwired Ethernet cable, when required. This is ideal for unmanned sites, where a dedicated HMI is not required.

See Publication [7000-UM201](#) for detailed instruction for the HMI Interface Board.

Drive Installation

This section details the processes for connecting cabinets and installing physical components such as fan hoods, as well as installing cabling, grounding, and interlocking the unit(s). Refer to the Transportation & Handling Guide for PowerFlex 7000 Medium Voltage Drives for details regarding siting and leveling drive cabinetry before continuing with the remaining installation tasks ([7000-IN008-EN-P](#)).

Where appropriate, separate diagrams and instructions are available for both the heat sink and the heat pipe “B” Frame models. Assume any “B” Frame diagram not specifically identified as a heat pipe model represents a heat sink model.

Safety and Codes



ATTENTION: The CEC, NEC, or local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire type, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Transporting and Siting the Drive

Follow all guidelines for siting the components before continuing with these installation procedures.

There may be some variation in the process depending on the type and number of drive components in your particular installation. Follow the correct procedures recommended for your particular components, and contact your Rockwell Automation sales or service representative if you have any questions during any part of the installation process.

Cabinet Layout and Dimensional Drawings of Drive

Generic dimensional drawings for the “B” Frame drives will be available in a forthcoming PowerFlex 7000 Reference Manual revision. Drawings specific to your unit and your installation are available as a package with your unit. For additional copies, or if you have questions, contact your Rockwell Automation sales representative.

Control/Cabling Cabinet

The following diagrams illustrate the medium voltage area, located in the control/cabling cabinet behind the low voltage compartment and with barriers removed.

Note: Heat pipes are only available within AFE rectifier “B” Frame models.

Figure 16 - Cabling cabinet for AFE rectifier (heat sink model)

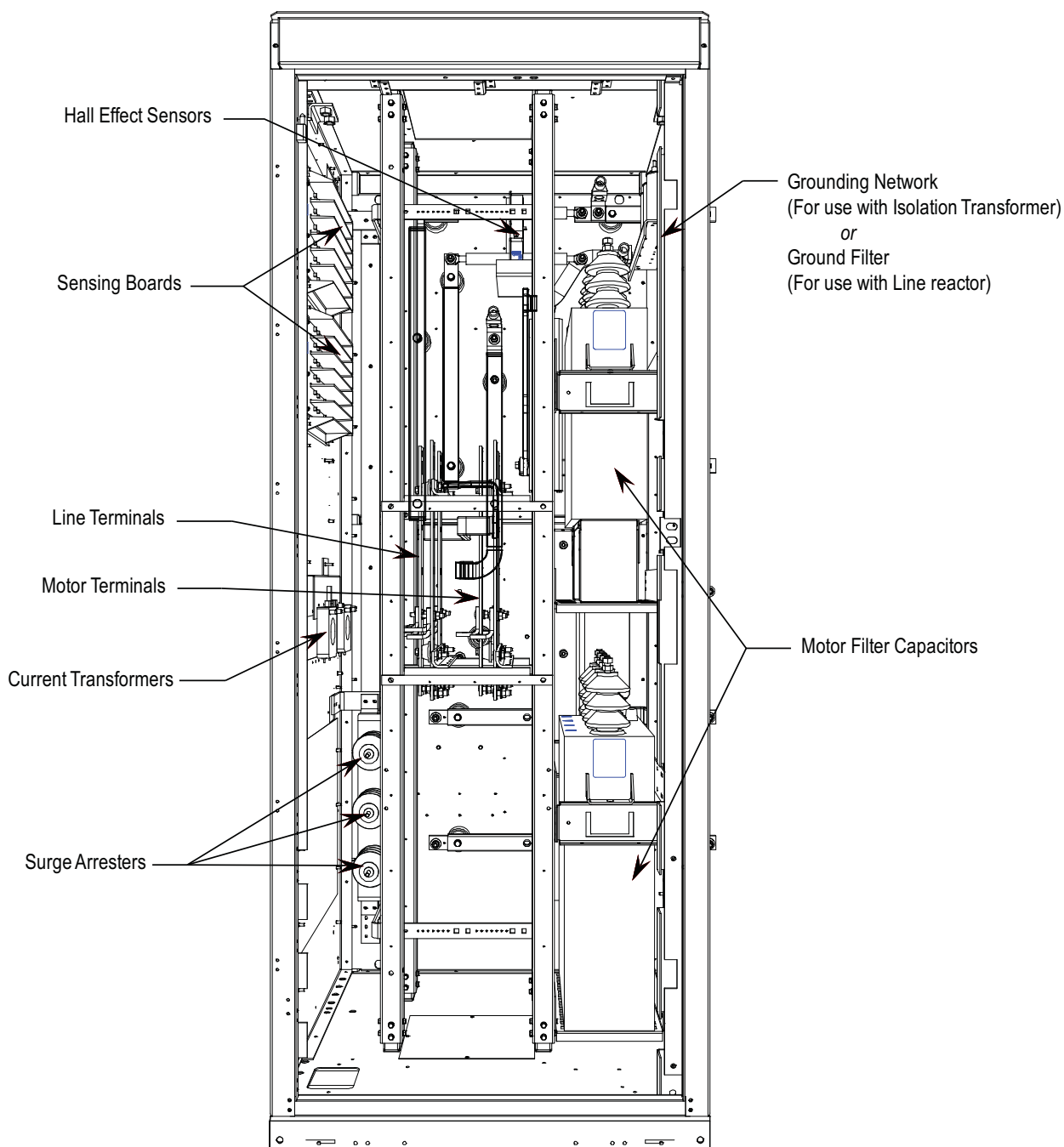


Figure 17 - Cabling cabinet for AFE rectifier (heat pipe model)

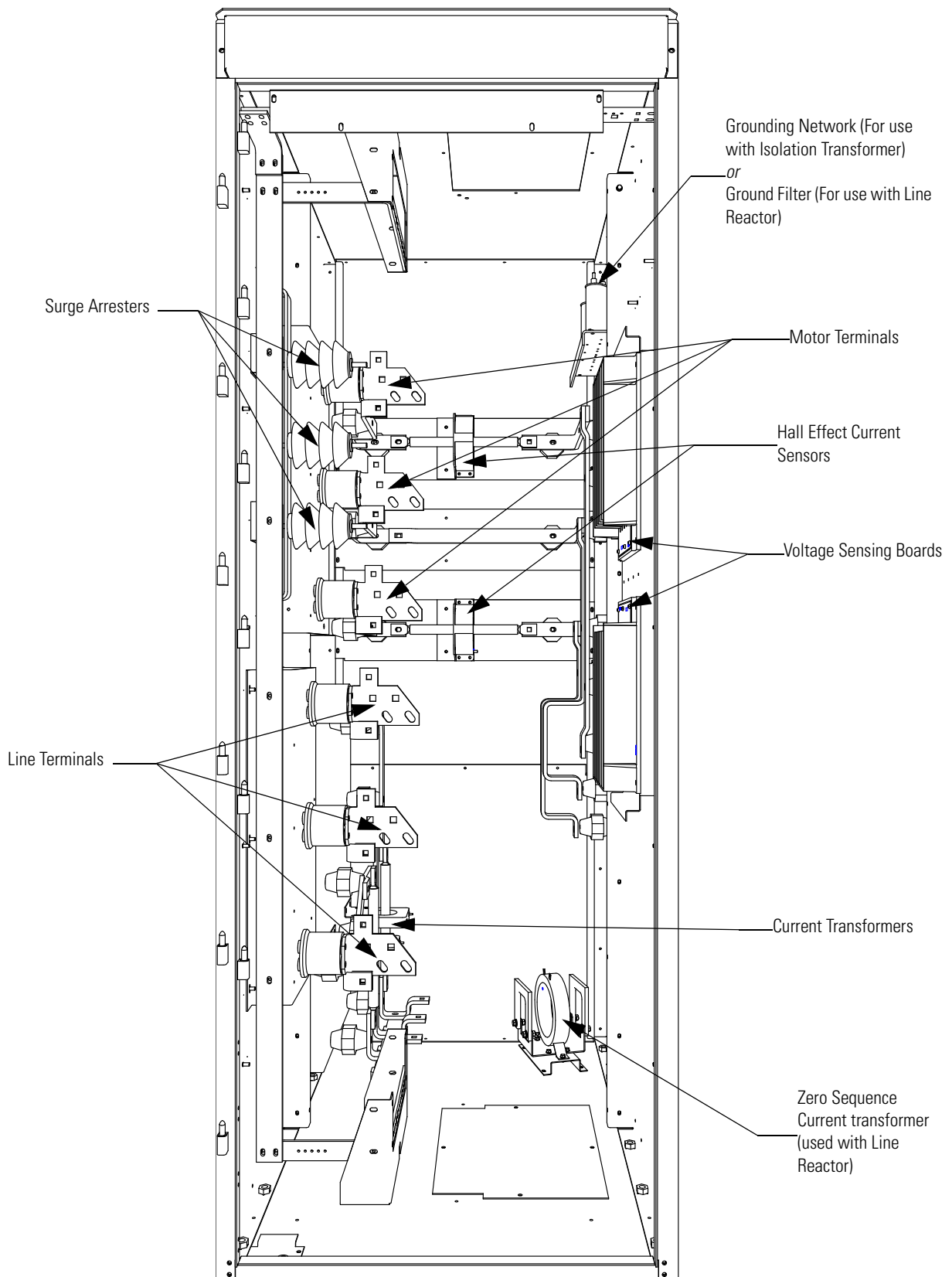


Figure 18 - Cabling Cabinet for AFE Rectifier (6600V heat pipe RPDTD)

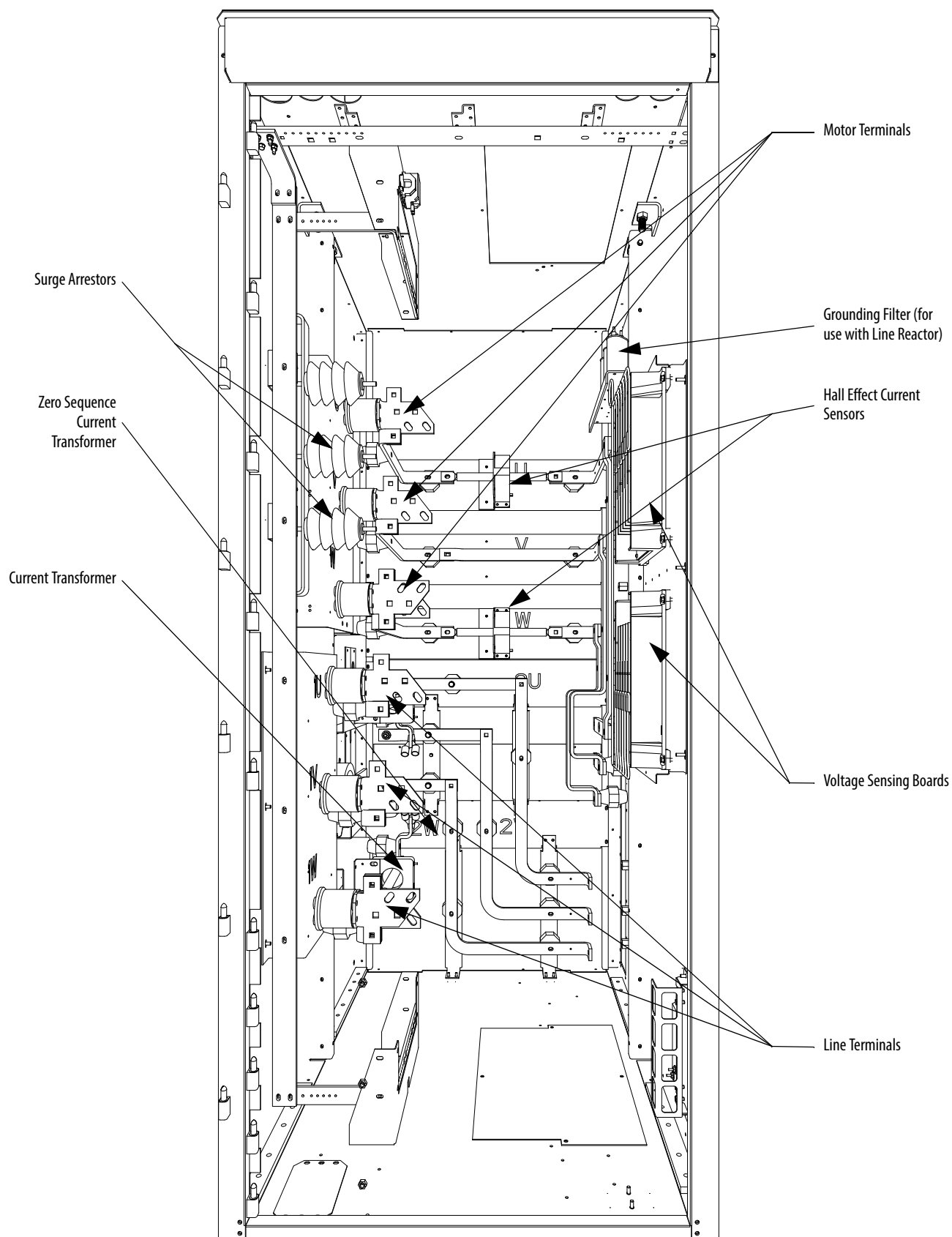


Figure 19 - Cabling Cabinet for 18 Pulse rectifier (motor filter capacitors not shown)

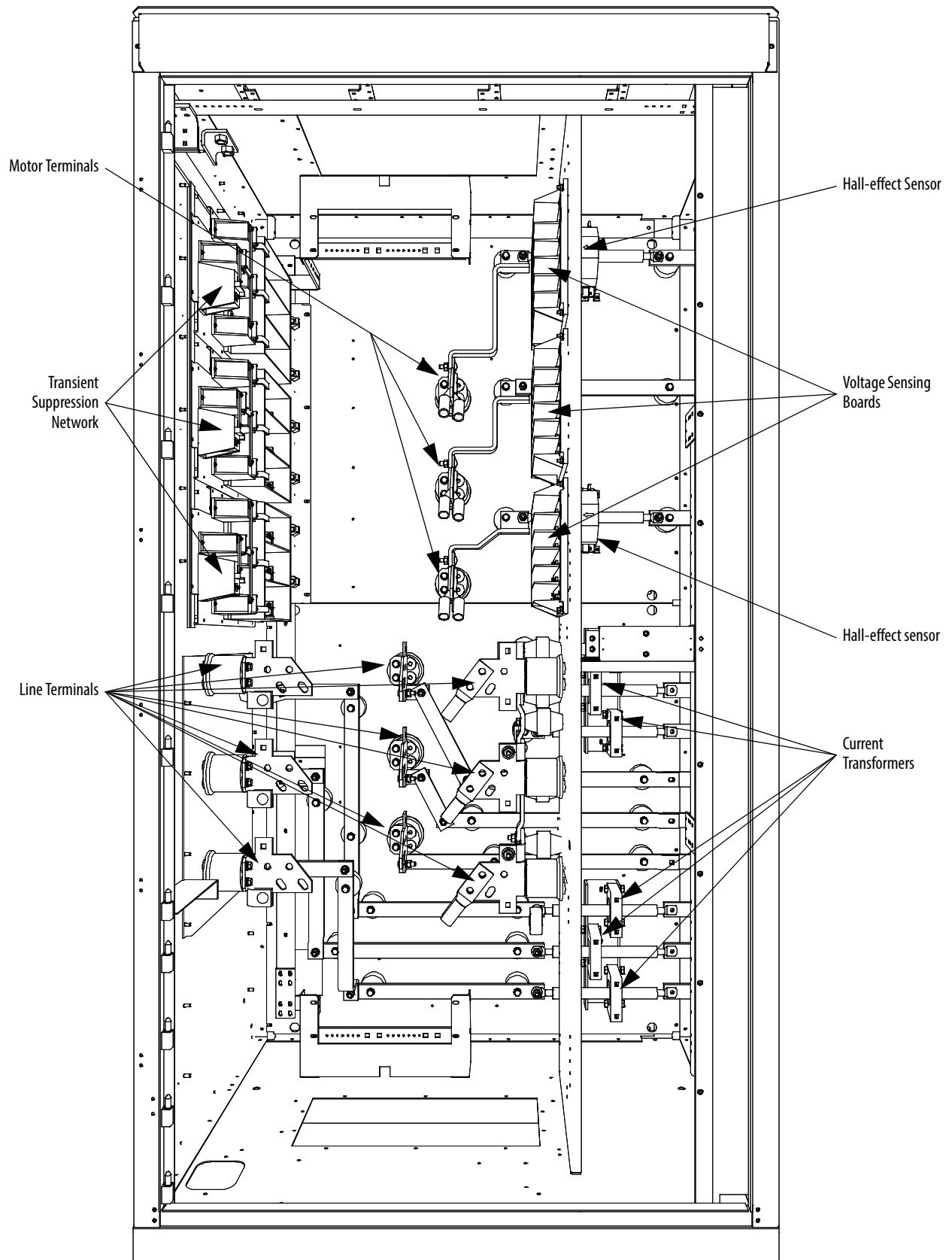


Figure 20 - AC Line Reactor for AFE rectifier with connection cabinet (heat sink model)

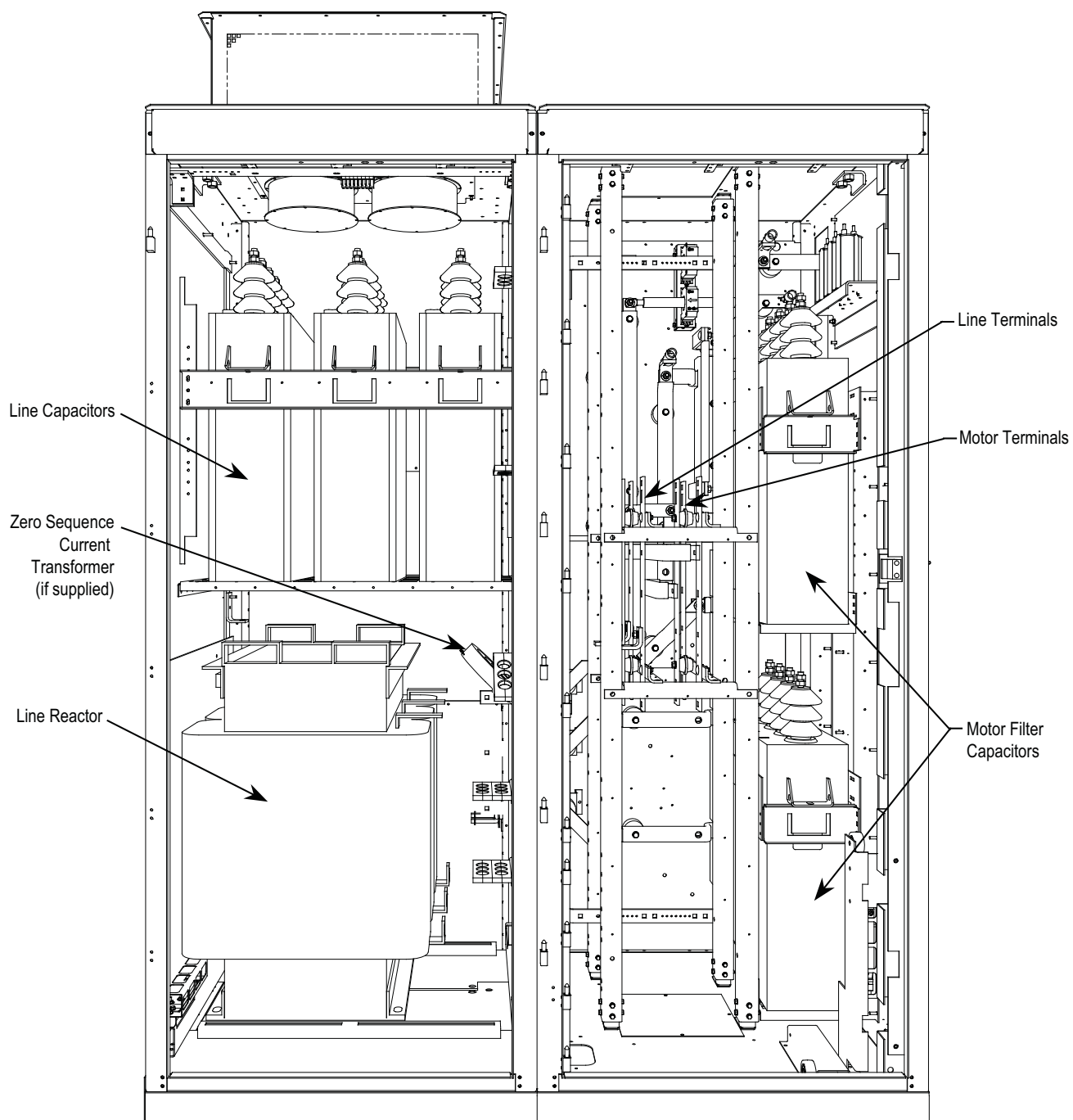


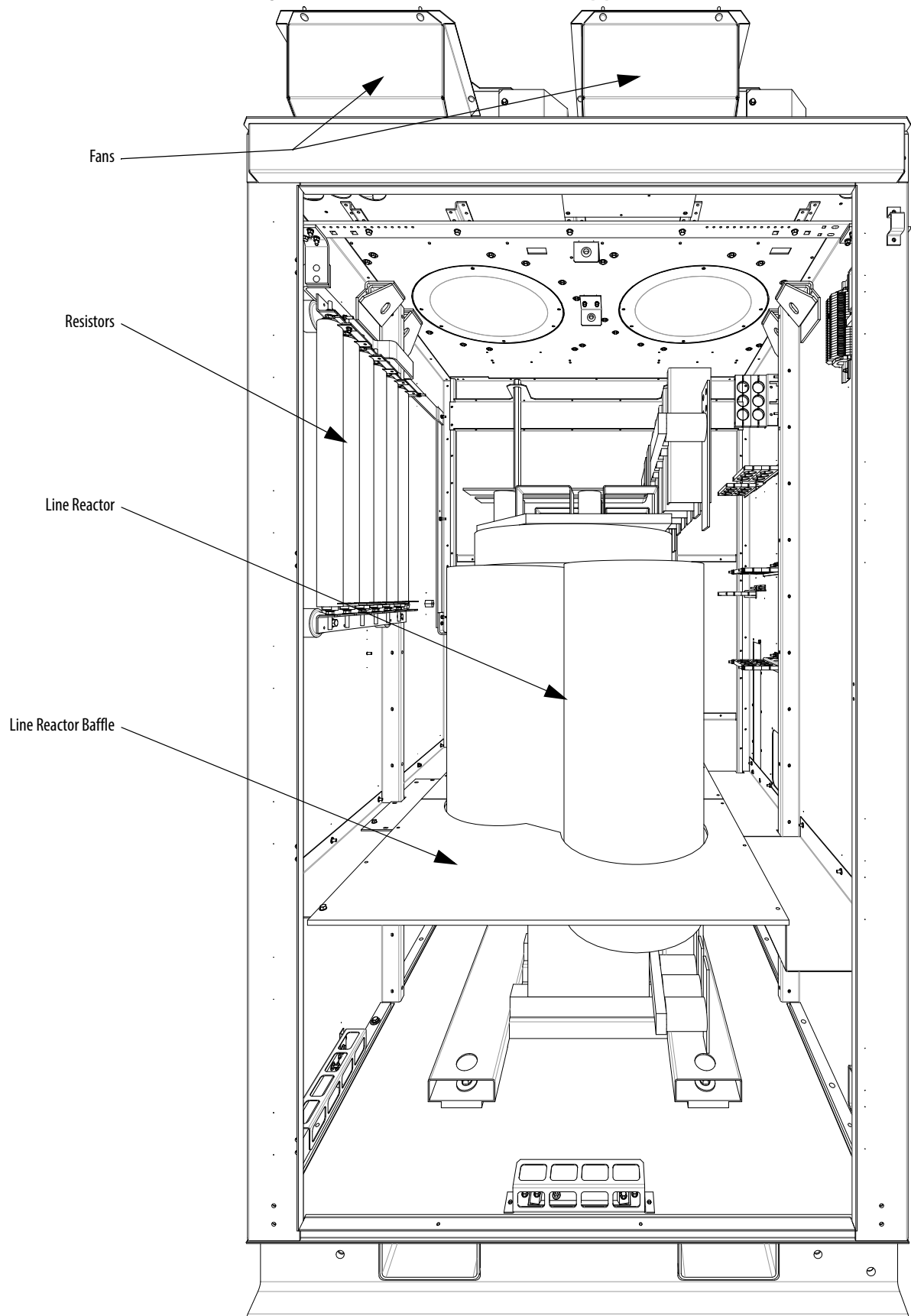
Figure 21 - AC Line Reactor Cabinet (6600V heat pipe RPDTD model)

Figure 22 - AC Line Reactor with connection cabinet (heat pipe model)

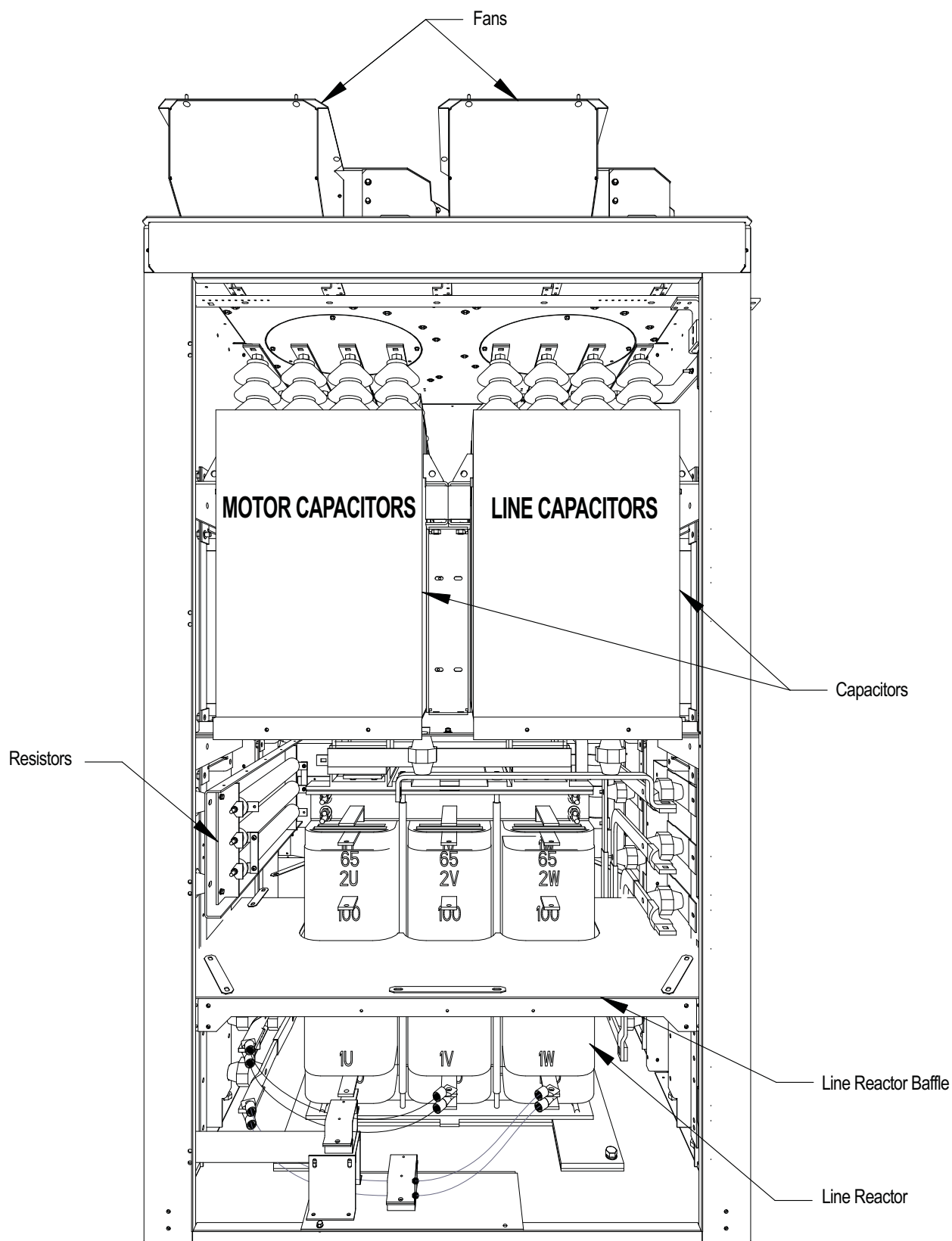
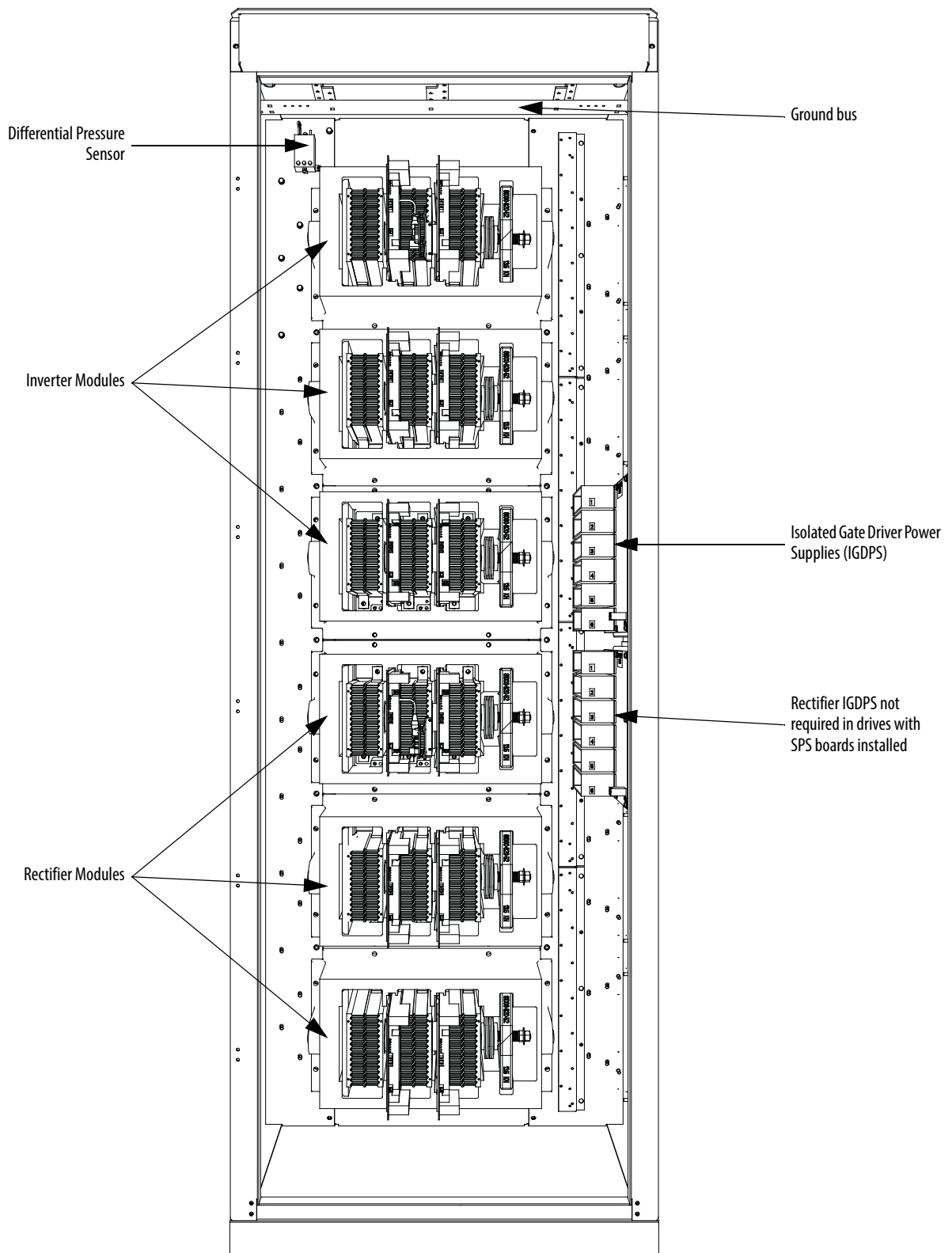


Figure 23 - Converter cabinet (heat sink model, 2400V version shown)



Note: There may be minor variations in the cabinet layout for different voltage classes. This installation manual does not show SPS boards installed.

Figure 24 - Converter cabinet (heat sink model, 3300...4160V version shown)

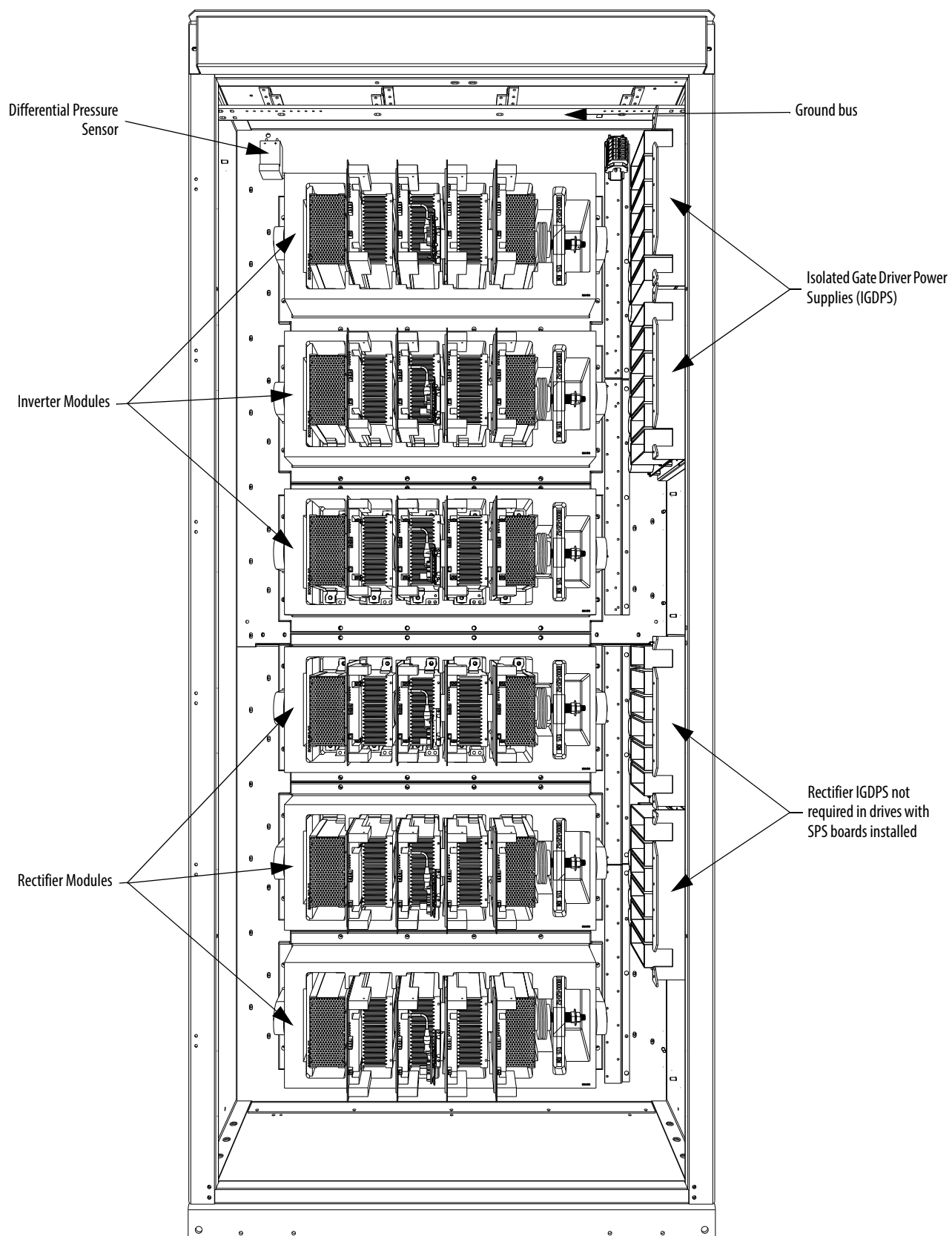


Figure 25 - Converter cabinet (heat sink model, 6600V version shown)

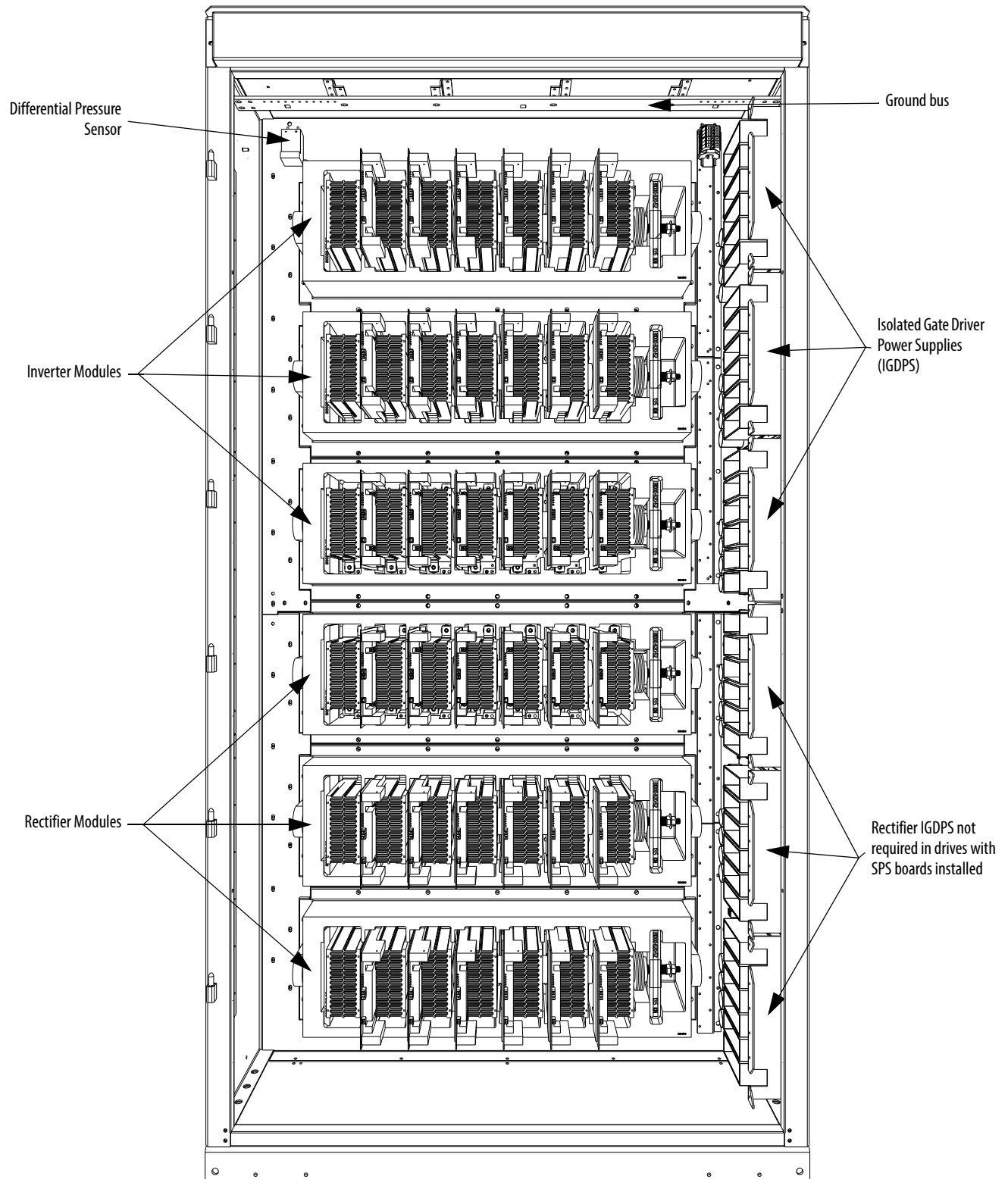


Figure 26 - Converter Cabinet, 3300...4160V (heat pipe model)

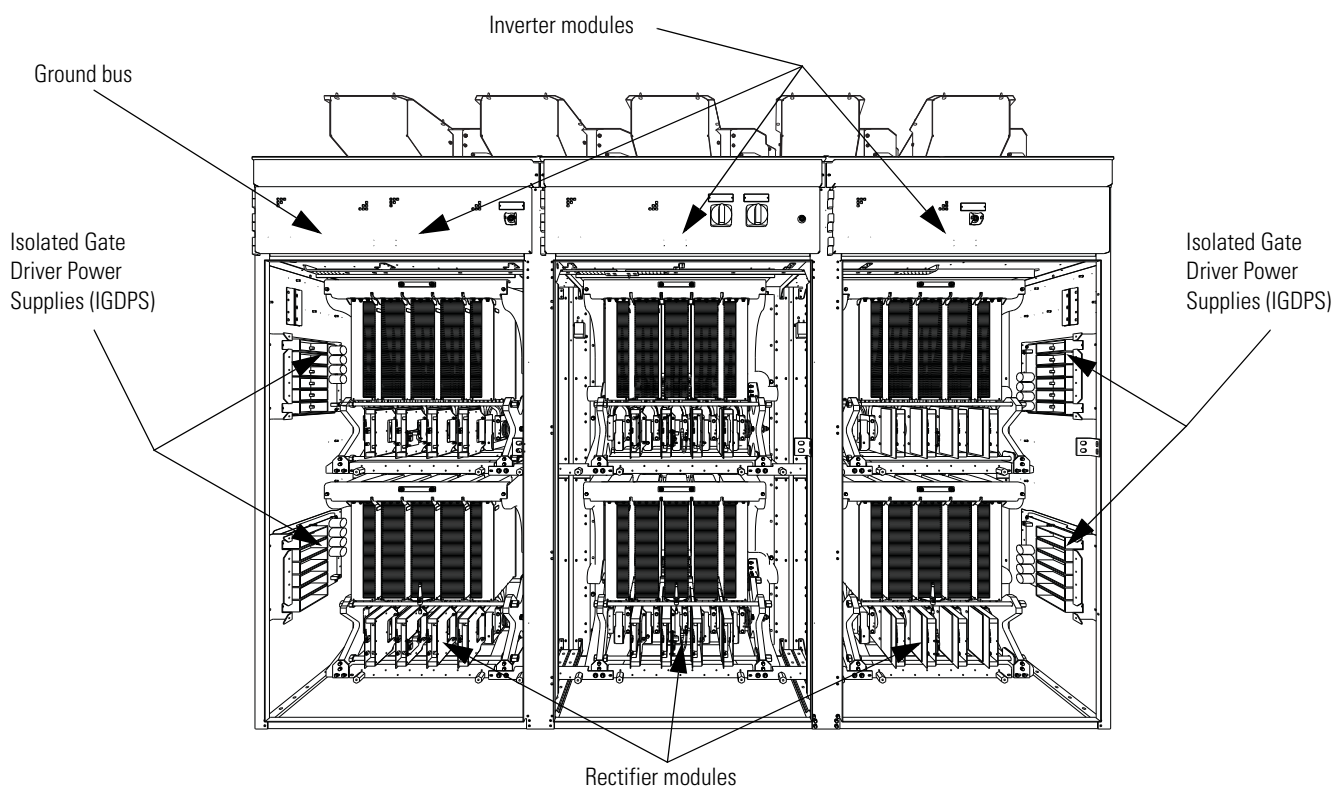


Figure 27 - Converter Cabinet, 6600V (heat pipe model)

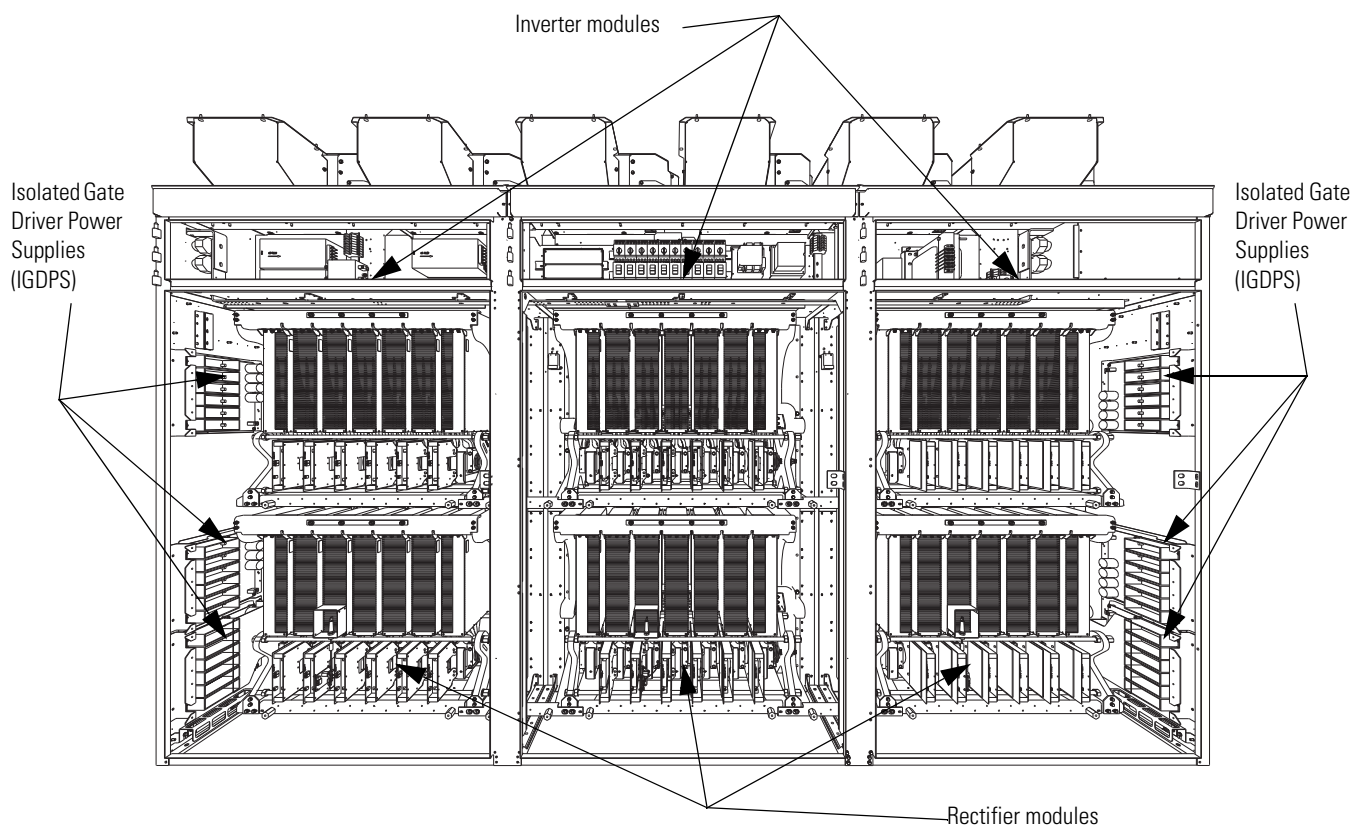


Figure 28 - DC Link/Fan cabinet with fan control panel (heat sink model)

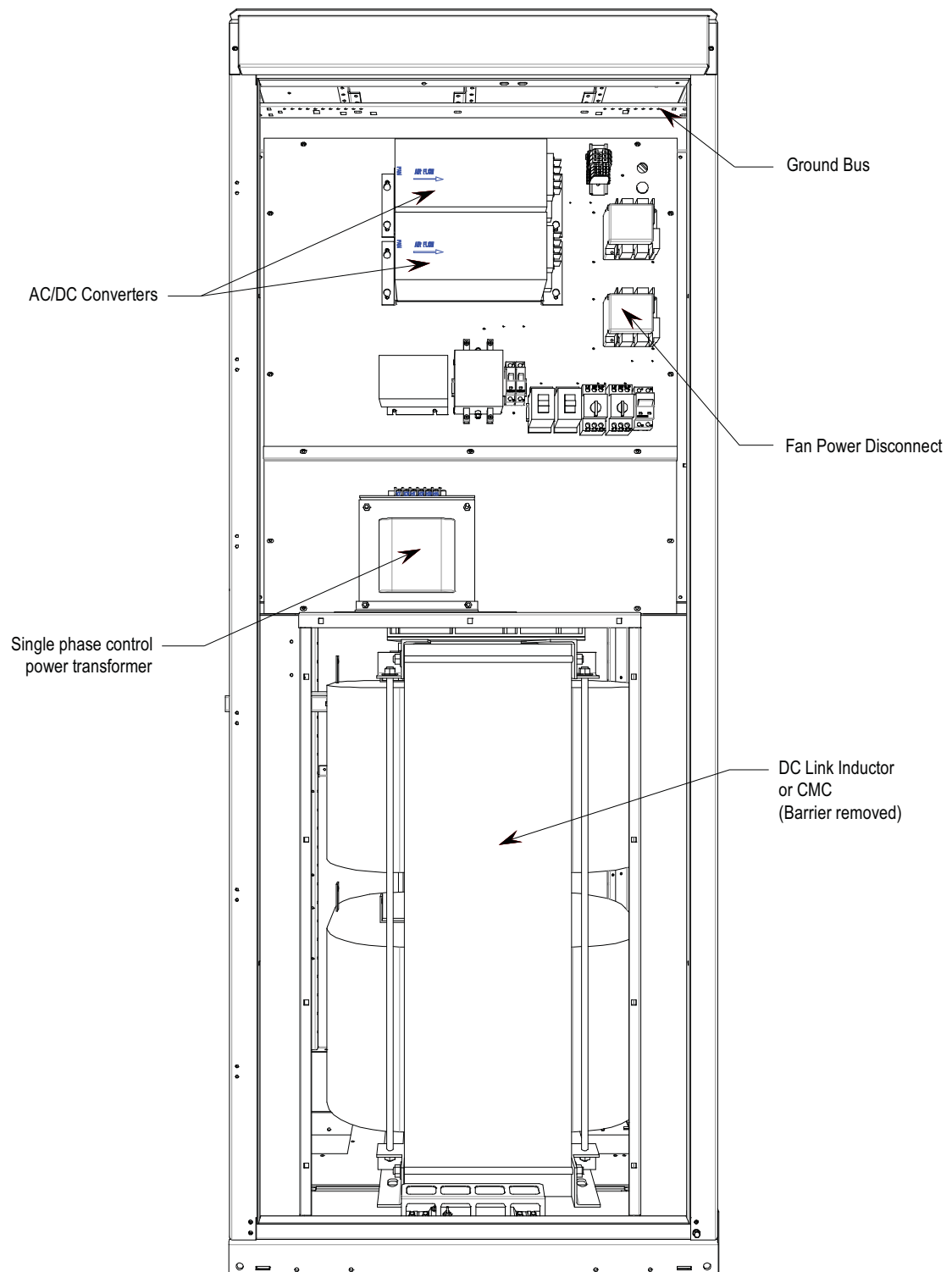


Figure 29 - DC Link/Fan cabinet with panel removed to show CMC (heat pipe model)

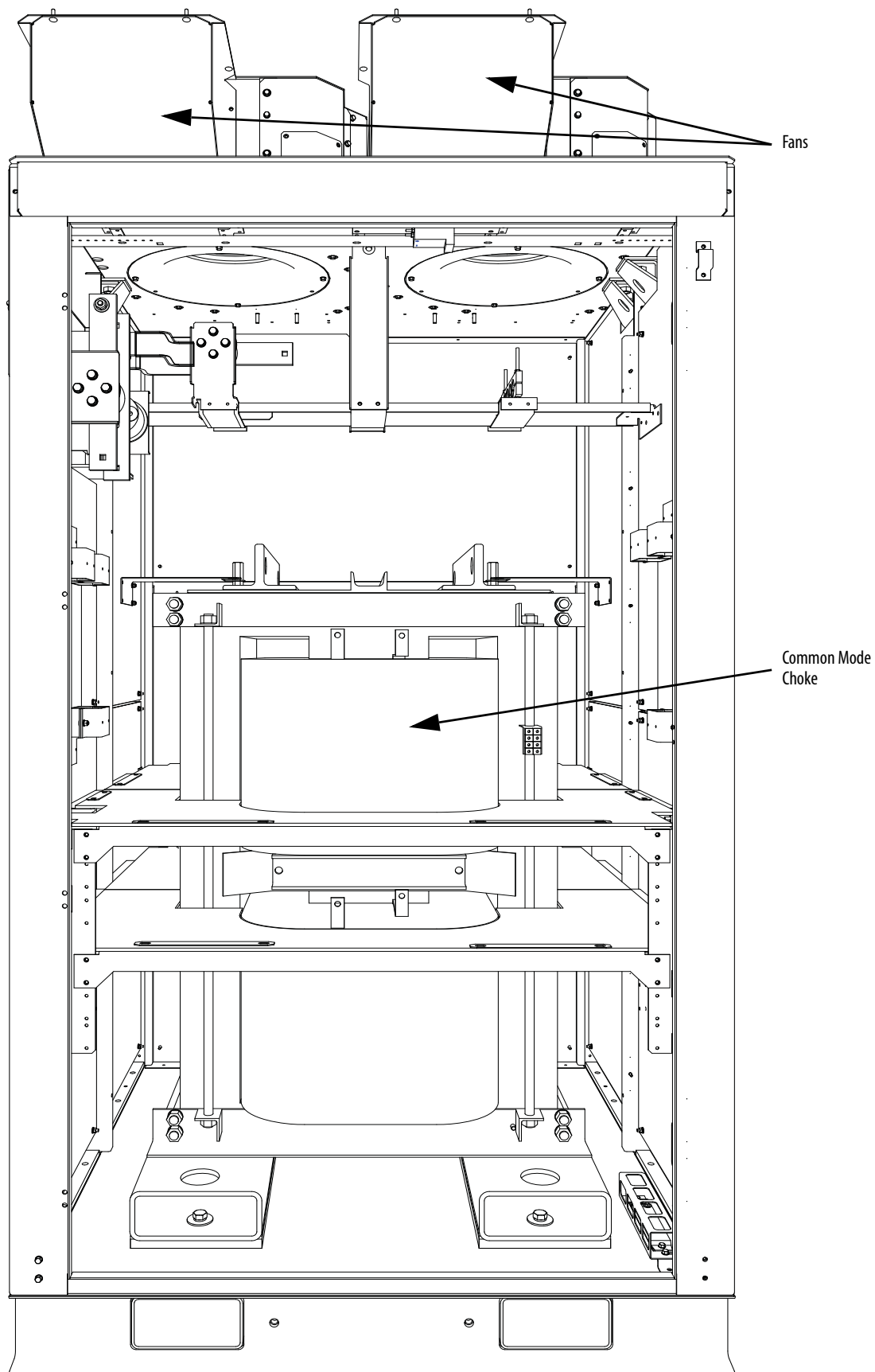
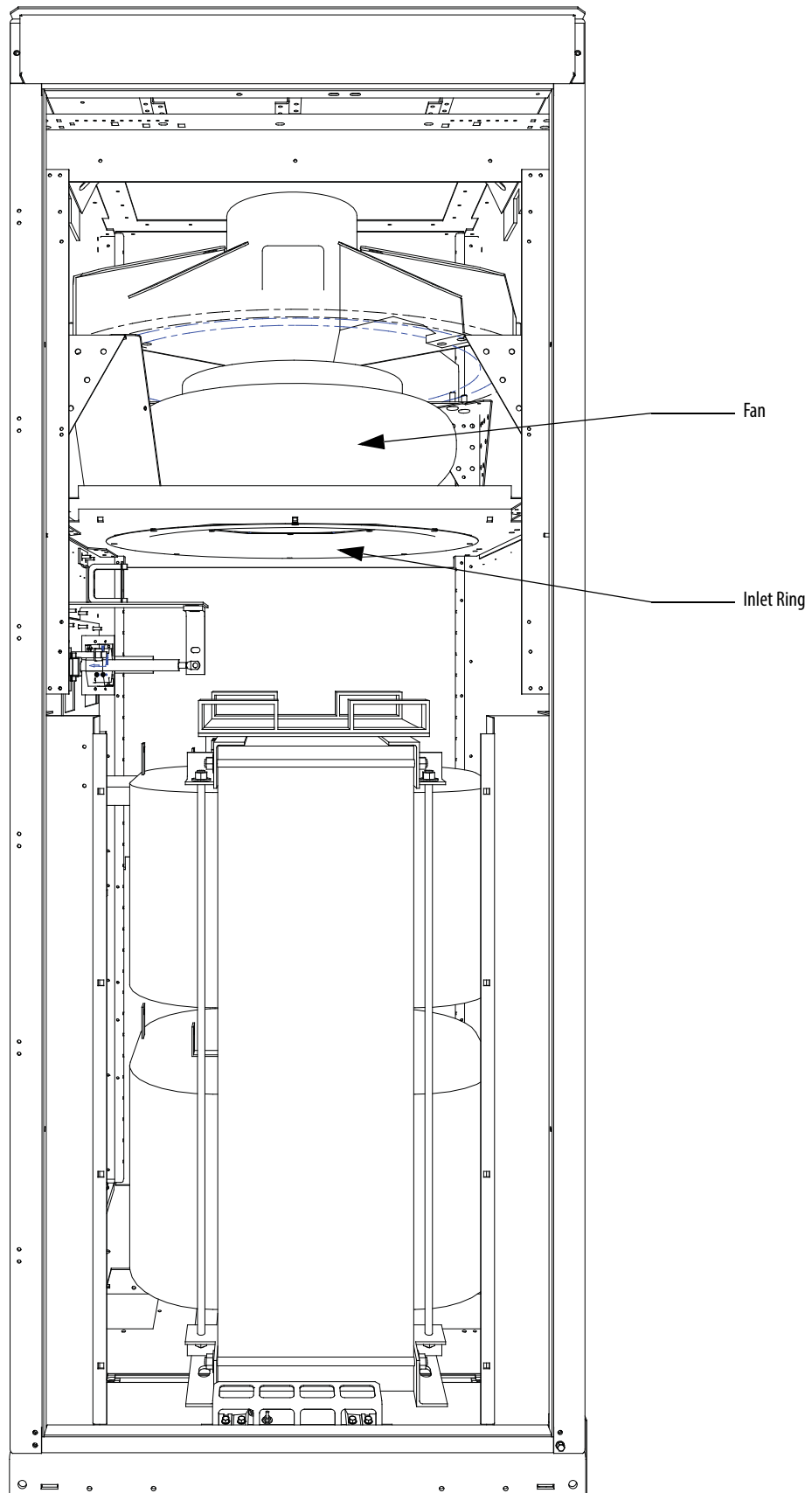


Figure 30 - DC Link/Fan cabinet with fan control panel removed to show main cooling fan



IEC Component and Device Designations

PowerFlex 7000 electrical drawings use IEC-based conventions, while remaining compatible with North American ANSI (American National Standards Institute) standards. Component-identifying symbols on the drawings are international; each PowerFlex 7000 elementary drawing (ED) set provides a full listing of these symbols. Each ED set also lists the device designations used on the drawings and labeling, with explanations.

Wiring identification uses a source/destination wire number convention on point to point multi-conductor wiring and elsewhere as warranted. The wire-numbering system of unique, single numbers for multi-drop and point to point wiring is common in general control and power wiring. Wiring that connects between the sheets, or that ends at one point and starts at another point on a drawing, has an arrow and drawing reference to indicate the ongoing connection.

The drawing reference indicates the sheet and the X/Y coordinates of the continuation point. Each drawing set contains a sheet explaining this reference system. The unique wire numbering system serves as confirmation that you are tracing the correct wire from sheet to sheet or across a drawing. Wires in multi-conductor cables are typically identified by color rather than by number. The abbreviations used to identify the colors on the drawings are fully identified on a sheet in the drawing set.

Power Wiring Selection

The following tables show general wire selections common to the PowerFlex 7000 drive installations.

General notes:

- Adherence to the following recommended field power cabling insulation levels for medium voltage drives ensures easier start-up and operation. Increase the cable insulation level over the default supplied for an across-the-line application with the same rated line-to-line voltage.
- Use either shielded or unshielded cable, based on the requirements of the distribution system designer and local standards. However, NEC requires shielded cable for installations above 2 kV.

Cable Insulation

These tables provide cable insulation requirements for the PowerFlex 7000 “B” Frame drive.



ATTENTION: Voltage ratings shown in the following tables are peak line-to-ground. Some cable manufacturers rate voltage line-to-line RMS. Ensure the cable meets the rating specified in the following tables.

Table 1 - Cable insulation requirements for AFE and 18 Pulse drives with isolation transformer

System Voltage (V, RMS)	Cable Insulation Rating (kV) (maximum peak line-to-ground)	
	Line Side	Machine Side
2400	≥4.1	≥2.2
3000	≥5.12	≥2.75
3300	≥5.63	≥3.0
4160	≥7.1	≥3.8
6000	≥10.8	≥5.5
6300	≥11.4	≥5.8
6600	≥11.8	≥6.0

Table 2 - Cable insulation requirements for “Direct-to-Drive” technology

System Voltage (V, RMS)	Cable Insulation Rating (kV) (maximum peak line-to-ground)	
	Line Side	Machine Side
2400	≥2.2	≥2.2
3000	≥2.75	≥2.75
3300	≥3.0	≥3.0
4160	≥3.8	≥3.8
6000	≥5.5	≥5.5
6300	≥5.8	≥5.8
6600	≥6.0	≥6.0

[Table 3](#) identifies general wire categories common to the PowerFlex 7000 “B” Frame drive. Each category has an associated wire group number, used in the following sections to identify the appropriate wire to use. The table also provides application and signal examples, along with the recommended type of cable for each group, and a matrix providing the recommended minimum spacing between different wire groups run in the same tray or separate conduit.

Table 3 - Wire group numbers

					For tray: Recommended spacing between different wire groups in the same tray For conduit: Recommended spacing for wire groups in separate conduit — mm (in.)						
Wire Category	Wire Group	Application	Signal Example	Recommended Cable	Wire Group	Power 1	Power 2	Control 3	Control 4	Signal 5	Signal 6
Power	1	AC Power (>600V AC)	2.3 kV, 3Ø AC lines	Per IEC / NEC Local Codes and Application Requirements	In tray	228.6 (9.00)	228.6 (9.00)	228.6 (9.00)	228.6 (9.00)		
					Between conduit	76.2 (3.00) Between conduit					
	2	AC Power (to 600V AC)	480V, 3Ø	Per IEC / NEC Local Codes and Application Requirements	In tray	228.6 (9.00)	228.6 (9.00)	152.4 (6.00)	152.4 (6.00)		
					Between conduit	76.2 (3.00) Between conduit					
Control	3	115V AC or 115V DC Logic	Relay logic PLC I/O	Per IEC / NEC Local Codes and Application Requirements	In tray	228.6 (9.00)	152.4 (6.00)	228.6 (9.00)	152.4 (6.00)		
		115V AC Power	Power supplies, instruments		Between conduit	76.2 (3.00) Between conduit					
	4	24V AC or 24V DC Logic	PLC I/O	Per IEC / NEC Local Codes and Application Requirements	In tray	228.6 (9.00)	152.4 (6.00)	152.4 (6.00)	228.6 (9.00)		
					Between conduit	76.2 (3.00) Between Conduit					
Signal	5	Analog Signals DC Supplies	5...24V DC supplies	Belden 8760 Belden 8770 Belden 9460							
		Digital (low speed)	Power supplies, TTL Logic Level								
	6	Digital (high speed)	Pulse Train, Input Encoder, PLC Communications	Belden 8760 Belden 9460 Belden 9463							
						All signal wiring must be run in separate steel conduit. A wire tray is not suitable. The minimum spacing between conduits containing different wire groups is 76.2 mm (3 in.).					

1. Belden 8760 - 18 AWG, twisted pair, shielded;
Belden 8770 - 18 AWG, 3 conductor, shielded
Belden 9460 - 18 AWG, twisted pair, shielded
Belden 9463 - 24 AWG, twisted pair, shielded
2. You may use steel conduit or cable tray for all PowerFlex 7000 Drive power or control wiring, and steel conduit is mandatory for all PowerFlex 7000 Drive signal wiring. Bring all input and output power wiring, control wiring or conduit through the drive conduit entry holes of the enclosure. Use appropriate connectors to maintain the environmental rating of the enclosure. The steel conduit is MANDATORY for all control and signal circuits, when installing the drive in European Union countries. The connection of the conduit to the enclosure shall be on full 360° and the ground bond at the junction shall be less than 0.1 Ω. In EU countries, this is a usual practice to install the control and signal wiring.
3. Spacing between wire groups is the recommended minimum for parallel runs of 61 m (200 ft) or less.
4. The customer is responsible for the grounding of shields. On drives shipped after November 28/02, the shields are removed from the drive boards. On drives shipped prior to November 28/02, all shields are connected at the drive end and you must remove these connections before grounding the shield at the customer end of the cable. You must ground shields for cables from one enclosure to another only at the source end cabinet. If you must splice shielded cables, the shield must remain continuous and insulated from ground.
5. AC and DC circuits must run through separate conduits or trays.
6. Voltage drop in motor leads may adversely affect motor starting and running performance. Installation and application requirements may dictate that larger wire sizes than indicated in IEC / NEC guidelines are used.

Select the wire sizes individually, observing all applicable safety and CEC or IEC/NEC regulations. The minimum permissible wire size does not necessarily result in the best operating economy. The minimum recommended size for the wires between the drive and the motor is the same as if using a main voltage source connection to the motor. The distance between the drive and motor may affect the size of the conductors used.

Consult the wiring diagrams and appropriate CEC or IEC/NEC regulations to determine correct power wiring. If you need assistance, contact your local Rockwell Automation Sales Office.

Installation

When you have placed the drive at the installation site, remove the lag bolts that fasten the shipping skid. Move the drive off the shipping skid and discard the skid. Position the drive in its desired location. Verify the drive is on a level surface and that the position of the drive will be vertical when you install the anchor bolts. The drive's dimension drawing will show the location of the provided anchor points.

Install and tighten the anchor bolts (M12 or ½" hardware required). Engineered bolt systems are mandatory for seismic requirements. Consult the factory for further information, if necessary.

Remove the top lifting angles and retain the hardware.

Install the hardware from the lifting angles in the tapped holes at the top of drive; this prevents leakage of cooling air as well as keeping dust out of the equipment.

Shock Indication Labels

Shock indication labels are devices that permanently record the physical shock occurring to the equipment.

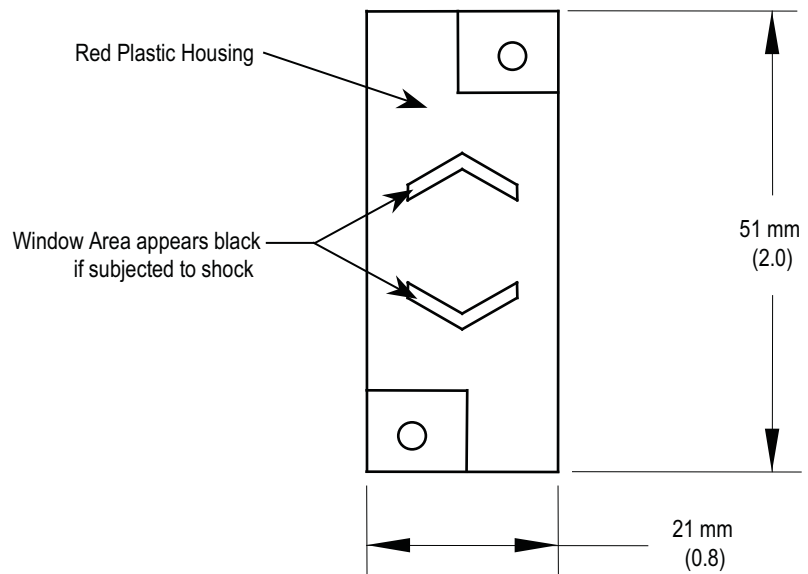
At the time of final preparation for shipment, the factory applies a shock indication label that records shock levels in excess of 10G on the inside door of the converter cabinet.

During the shipping and installation process drives may inadvertently experience excess shock and vibration which may impair its functionality. When you have situated the drive in its installation area, open the converter door and inspect the shock indication labels.

If sufficient shock levels occur, the chevron shaped window will appear black in one of the two windows. Record the shock values. There is a greater possibility of the drive having sustained internal damage as the result of physical shock during the shipping and installation process.

Even if the shock indicators are clear, perform a full equipment inspection and verification. Refer to [Pre-Commissioning Responsibilities on page 65](#) for details on the inspection and verification process.

Figure 31 - Shock Indicator



Joining Shipping Splits (3300...4160V and 6600V Heat Pipe Model)

IMPORTANT Refer to publication [7000-IN008 -EN-P](#) for details regarding moving and siting the drive before continuing with these installation procedures.

The 3300...4160 and 6600V heat pipe drives are the “B” Frame models that ship in multiple sections (two for 3300...4160V and three for 6600V). All other “B” Frame models ship as a single unit. For the 3300...4160V heat pipe model, the choke section ships separately from main section of the drive ([Figure 32](#)). For the 6600V heat pipe model, the choke cabinet and the line reactor section ship separately from the main section of the drive ([Figure 33](#)).



ATTENTION: Install the drive on a level surface (+/- 1 mm over the length of the drive). Use metal shims if necessary to level the cabinets before joining them; attempting to level after joining may result in twisting the cabinets.

Arrange the sections as directed in the dimension drawings and move the sections together. Join the enclosure’s side sheets with thread-forming screws using the available holes.

Complete ground bus, power, and control connections as directed in the electrical diagrams and this installation guide.

1. Attach choke section to main section of the drive.

Figure 32 - Main and choke sections of 3300...4160V heat pipe drive cabinetry

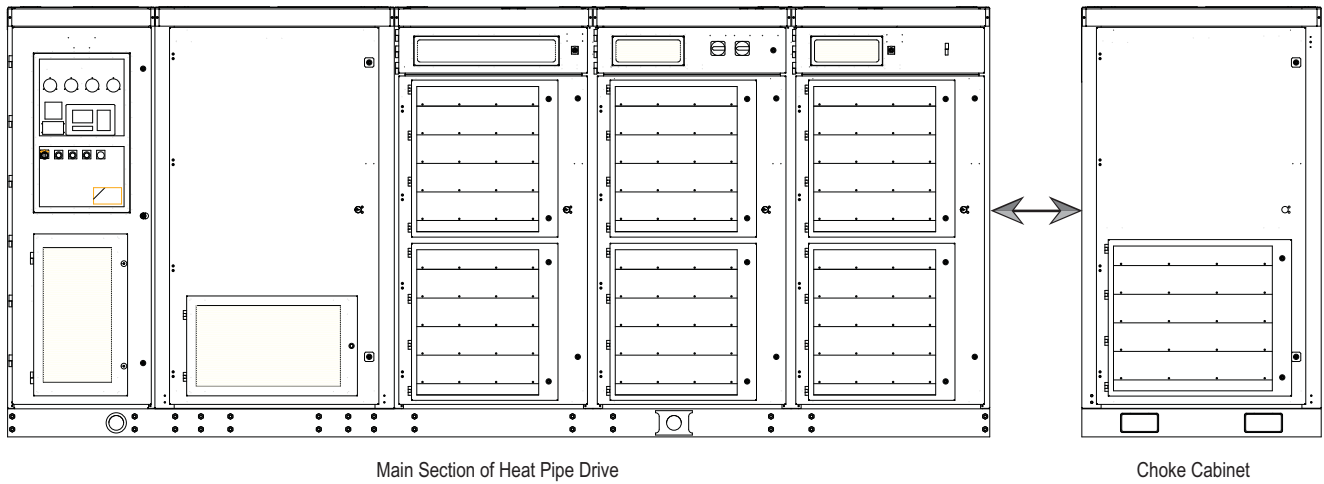
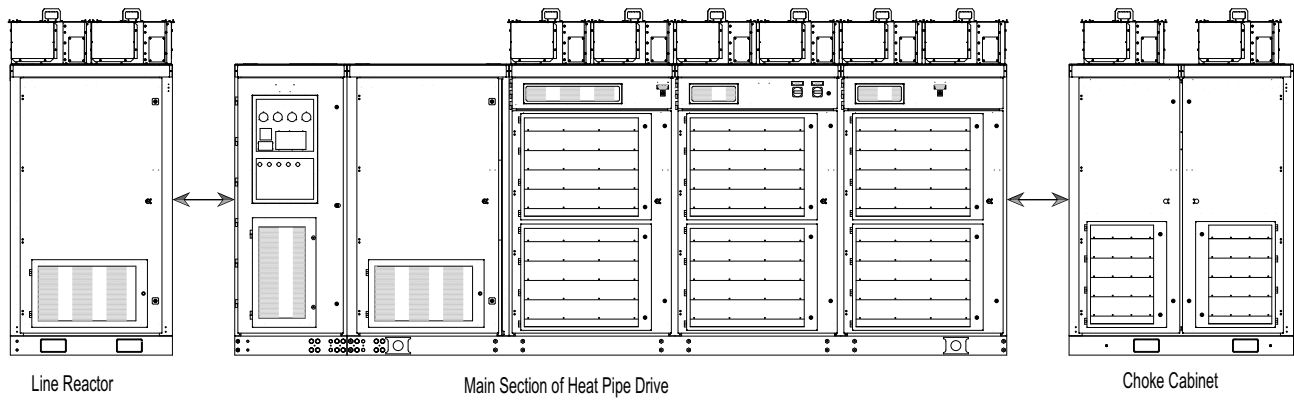
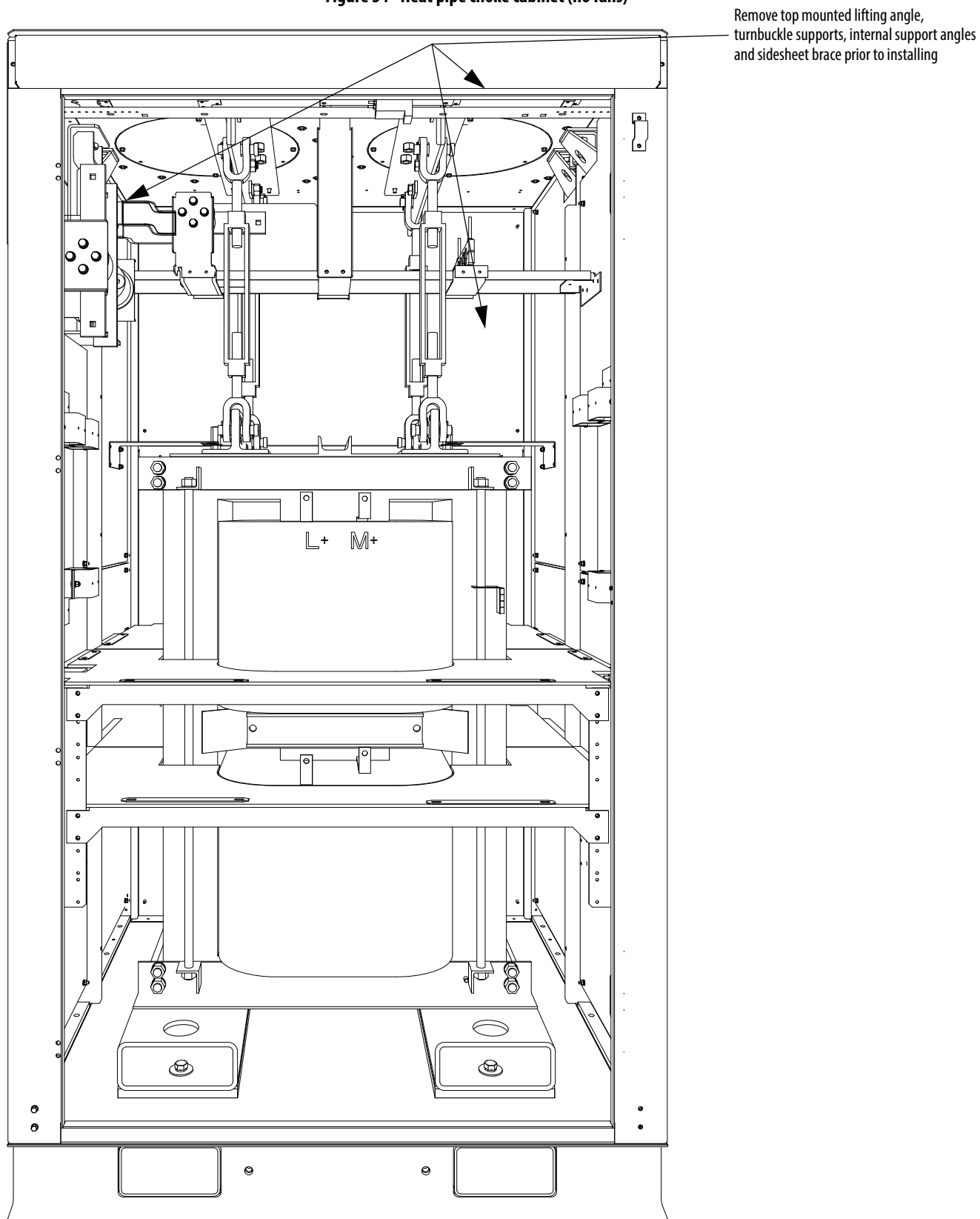


Figure 33 - Main and choke sections of 6600V heat pipe drive cabinetry



2. Remove the lifting supports in the choke cabinet used for shipping and retain for future use.

Figure 34 - Heat pipe choke cabinet (no fans)



3. Use M10 hardware to join the choke cabinet's sidesheet to main drive cabinet's sidesheet.

[Figure 37](#) shows bracket 81003-929 in the right cabinet representation. When installing these cabinets together, abut these cabinets along their side walls and align the cabinet fronts with no gaps. These alignments are crucial for correctly aligning the plumbing and bus connectors at the back of the cabinet. Failure to do so can cause undue stress on plumbing joints and leaks. Use brackets 81003-929 as shown to secure the cabinet alignment.

Figure 35 - Aligning and joining heat pipe main and choke cabinets (for 3300...4160V and 6600V)

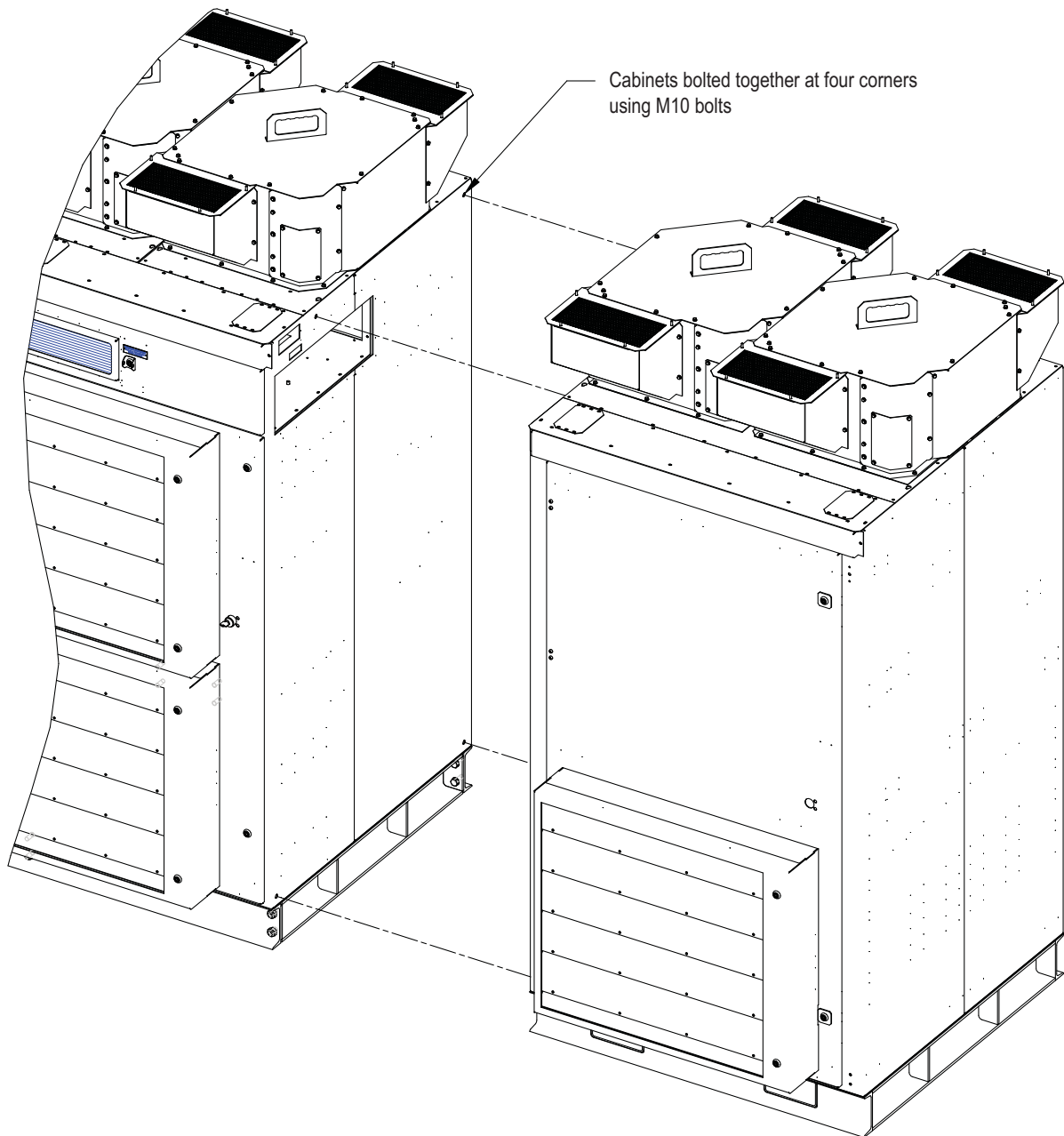
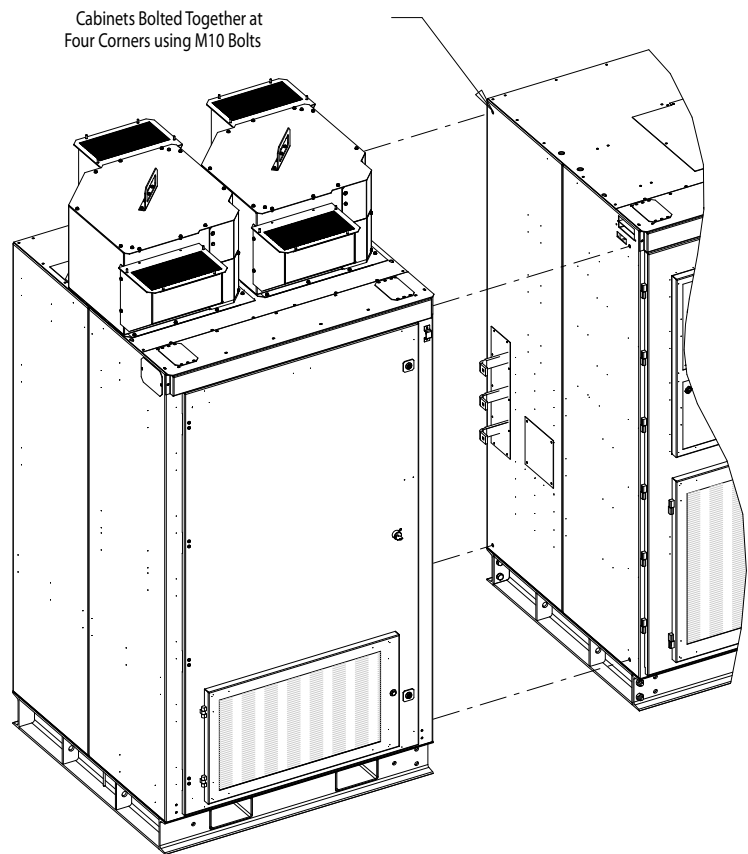
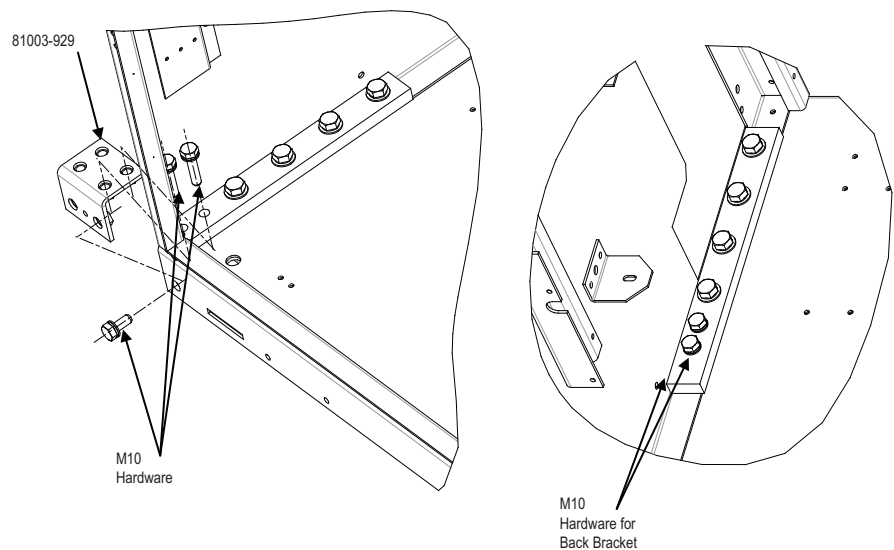


Figure 36 - Aligning and joining heat pipe main and Line Reactor (for 6600V only)



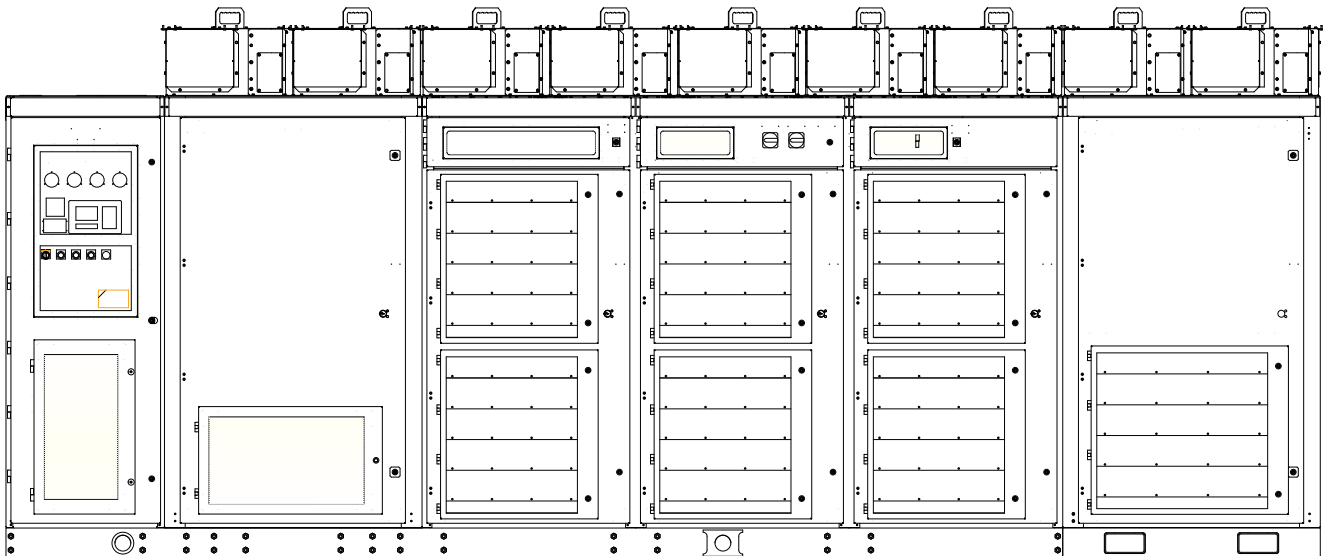
NOTE: There is no required order of operations for installing fans and hoods and joining cabinets. Joining cabinets first allows roof-top access to the upper bolts, but these are also accessible from the front if you choose to install the fans first.

Figure 37 - Connecting the cabinets with M10 hardware (split drives only)



4. Install top mounted fans.

Figure 38 - 3300...4160V heat pipe drive with fans attached



5. Connect the cables from the choke to M+, M-, L-, L+ bus connections at the top left corner of the choke cabinet.

Installing Exhaust Fans and Air Hoods

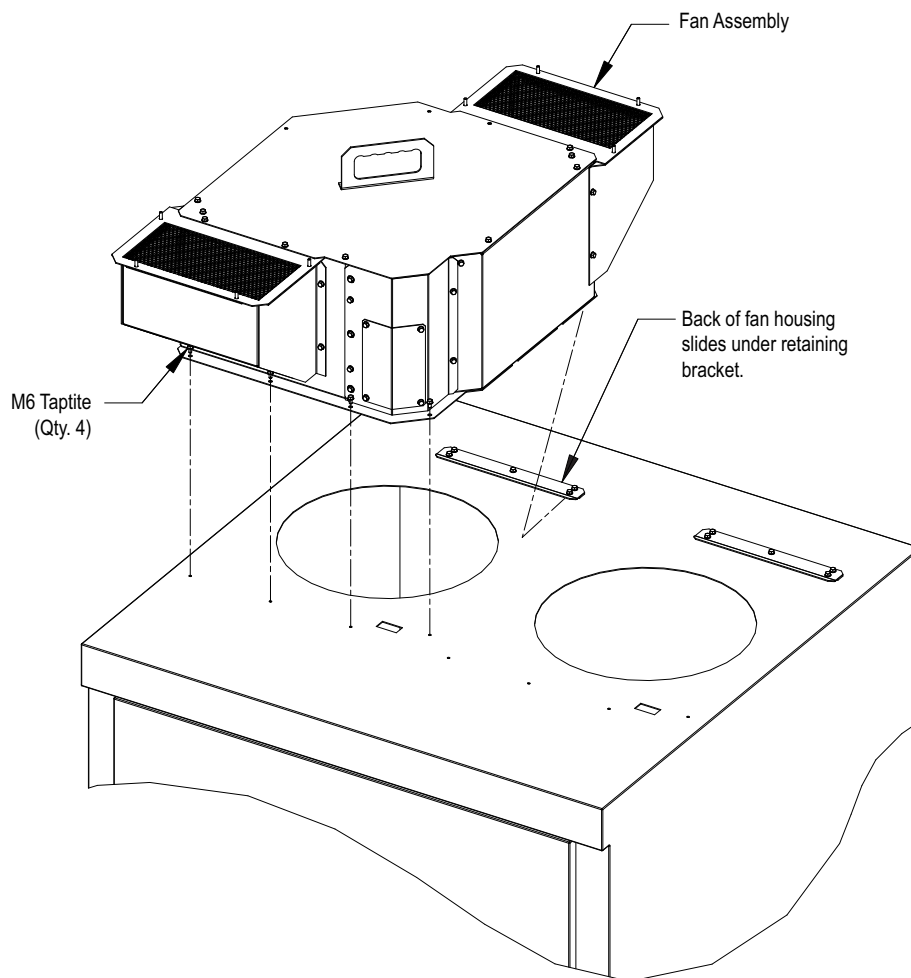
Install a sheet metal exhaust hood on the top of the cabinet with the cooling fan. The exhaust hood components ship with the drive, packed in the control/cabling cabinet. (For drives with an acoustic hood, the components are shipped assembled, as shown in [Figure 41](#)).

Remove the protective plate covering the fan opening on the drive. It is a flat cover plate bolted to the top plate. Remove the bolts and plate and retain for re-use.

Assembling Exhaust Fans

The cabinet-top fan assembly is similar to the model shown in [Figure 39](#):

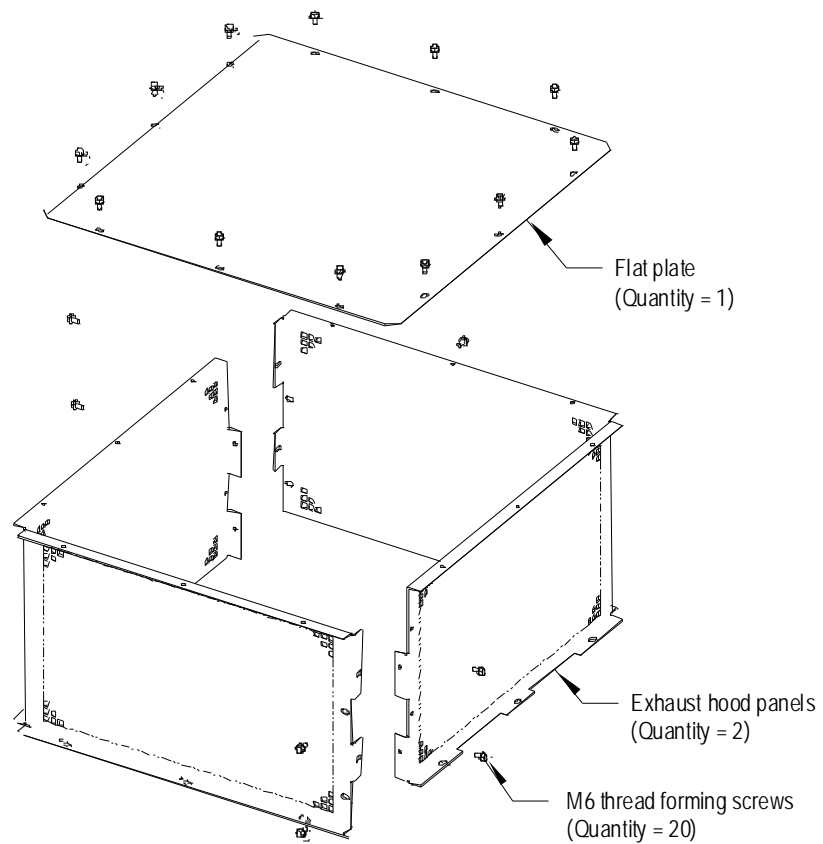
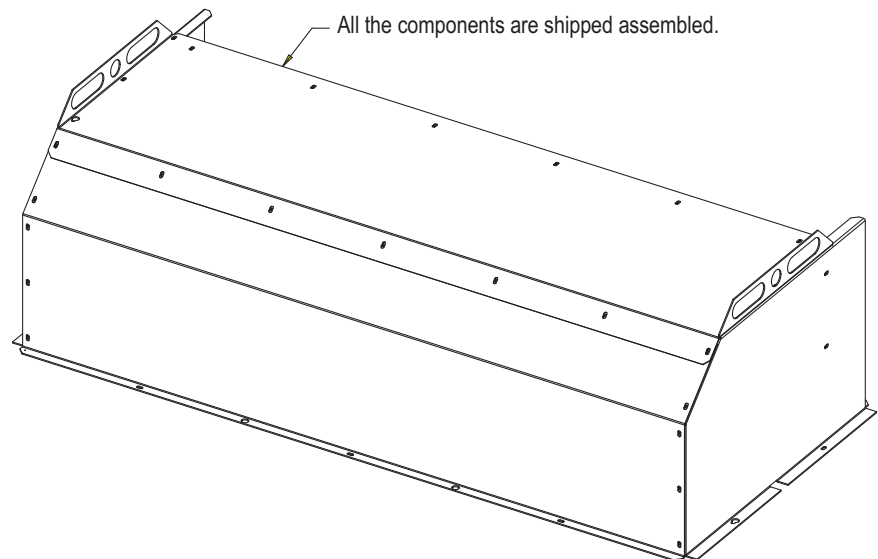
Figure 39 - Fan assembly (heat pipe model shown)



Slide the edge of the fan housing's bottom edge under the retention bracket, and anchor the M6 hardware in the locations shown.

Assembling Fan Hoods

Assemble the two L-shaped panel components shipped with the drive as shown in [Figure 41](#).

Figure 40 - Fan hood assembly**Figure 41 - Acoustic can hood assembly**

Locate the exhaust hood on top of the cabinet as show in [Figure 43](#), and re-install the original cover plate previously set aside. Align the notches on the bottom flange toward the sides of the drive. Affix the assembly to the drive top plate, and tighten all hardware.

For drives with an acoustic hood (shown in [Figure 41](#)), locate the exhaust hood (refer to [Figure 43](#)).



ATTENTION: Ensure you retrieve any screws that accidentally fall into the equipment to avoid potential damage or injury.

Figure 42 - Fan hood installation

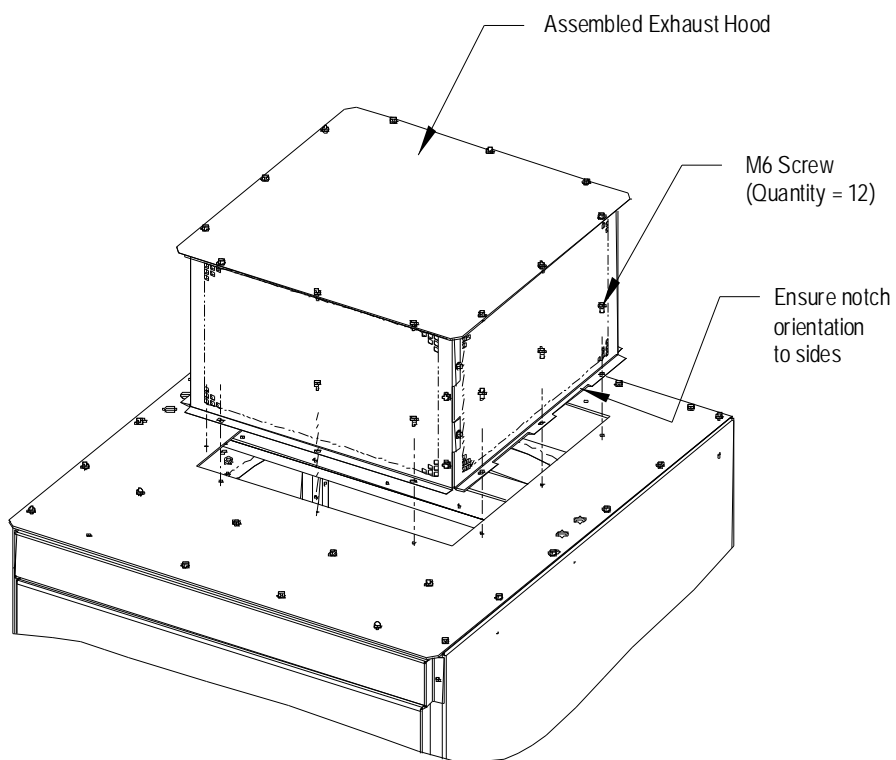
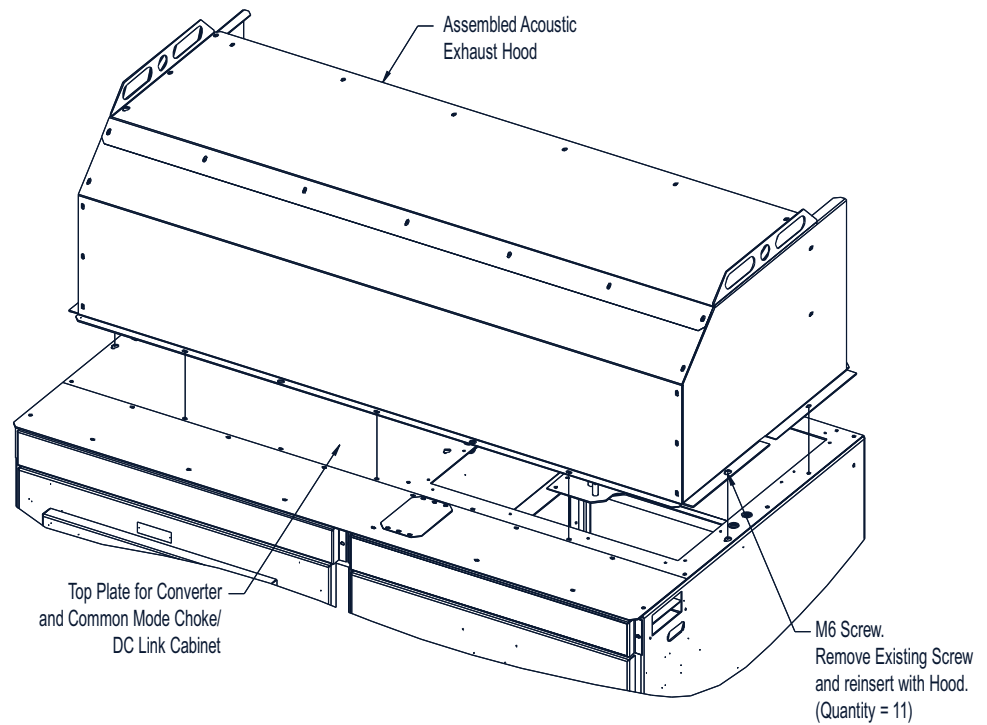
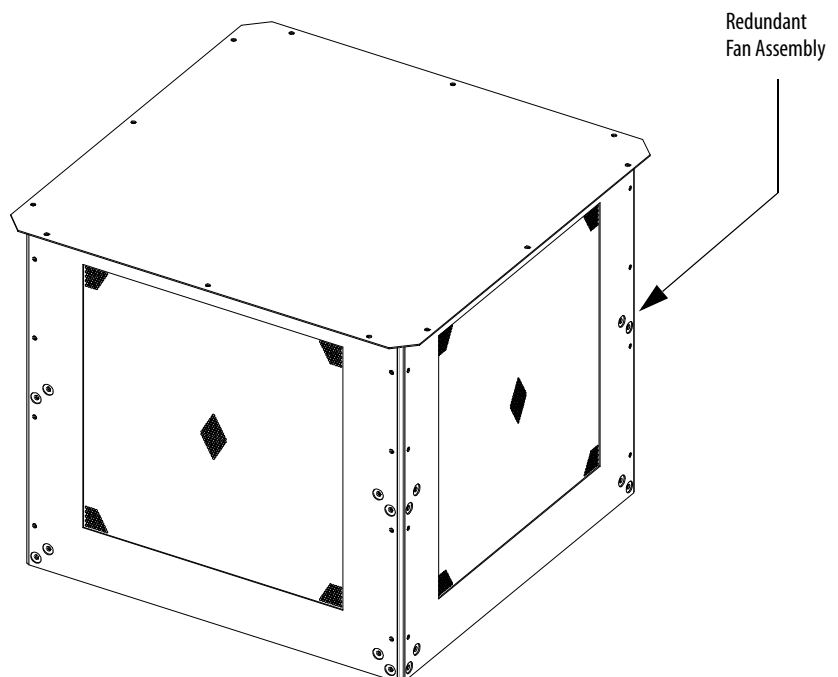


Figure 43 - Acoustic fan hood installation

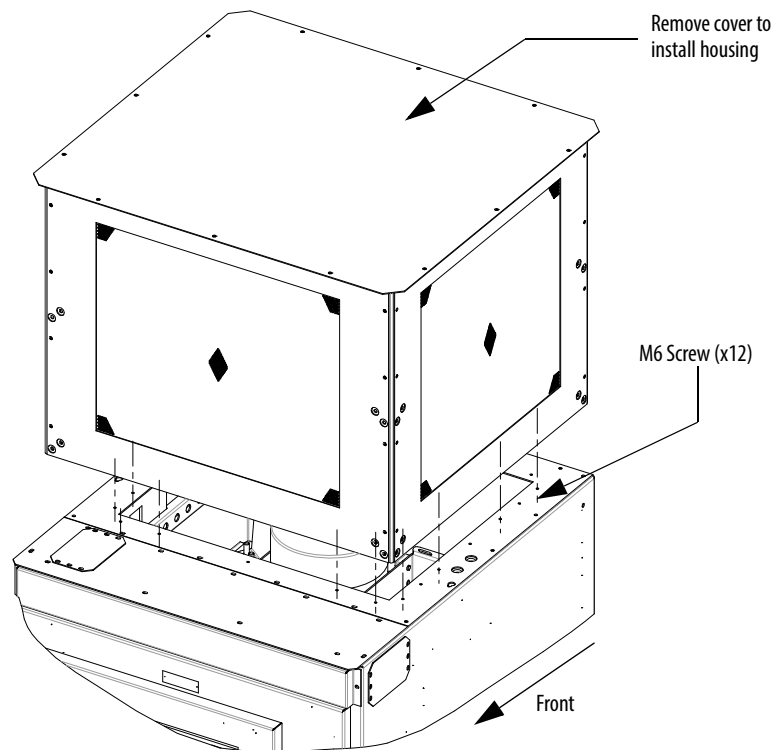
Installation of Redundant Fan Assembly

Redundant Fan components are shipped already assembled ([Figure 44](#)).

Figure 44 - Redundant Fan Assembly

1. Remove and discard the protective plate and associated hardware covering the fan opening on the cabinet.
2. Remove the top cover of the fan housing and set aside.
3. Remove the shipping cover plate on the bottom of the redundant fan assembly and discard.
4. Position the assembly over the opening, verifying the locating hole on the housing base aligns with the front right side of the cabinet.
5. Align the mounting holes and wire harness connections.

Figure 45 - Redundant Fan Assembly Orientation



6. Affix the redundant fan assembly to the drive top plate with the M6 thread forming screws provided.
7. Connect the fan wire harness to fan.
8. Reinstall the top cover onto the fan housing and tighten all hardware.

External Ducting

The PowerFlex 7000 design conducts exhaust air outside of the control room, requiring special consideration for conditions present in the atmosphere outside the control room.



ATTENTION: If the drive configuration includes multiple exhaust outlets, duct each outlet separately to prevent back-feeding hot exhaust into the drive.

The following requirements are mandatory for systems that will externally duct the exhaust air and draw cleansed outside air:

- External ducting including an external filtering system must not add more than 50 Pa (0.2 in. of water) pressure drop to the PowerFlex 7000 drive air flow system. For heat pipe models, ensure a minimum top clearance of 600 mm (24 in.) above fan exhaust openings.
- The control room must provide slightly more make-up air, creating a pressurized room. This slight pressurization prevents unfiltered air drawing into the room.
- The drive is intended to operate in conditions with no special precautions to minimize the presence of sand or dust, but not in close proximity to sand or dust sources. IEC 7211 defines this as being less than 0.2 mg/m^3 of dust. If outside air does not meet this condition, filter the air to ASHRAE (American Association of Heating, Refrigeration and Air-Conditioning Engineers) Standard 52.2 MERV 11 (Minimum Efficiency Reporting Value). This filtration eliminates from 65% to 80% of the particulate in Range 2 ($1.0\text{--}3.0 \mu\text{m}$) and 85% of the particulate in Range 3 ($3.0\text{--}10.0 \mu\text{m}$). Clean or change filters regularly to ensure proper flow.
- The make-up air must be between $2\text{--}40^\circ\text{C}$.
- Relative humidity must be less than 95% non-condensing.
- Approximately 10% of drive losses will still be rejected into the control room; address this issue as needed to maintain the temperature in the control room within specification.
- Failure to maintain proper flow of cooling air into the control room can result in the drive stopping on low differential pressure across the heat sinks.

Power Cabling Access

The drive's cabinetry provides for either the top or bottom power cable entry.

Cable access plates are available on the top and bottom plates of the connection cabinet; check your customer-specific dimension drawings for details.

To access the customer power cable terminations:

1. Open the door of the low voltage control compartment. The low voltage control compartment is hinged on its left side. The power terminals are behind the low voltage control compartment.
The key interlock prevents the low voltage control compartment from swinging open unless the medium voltage source is locked out.
2. Turn each of the three latches on the right side of the low voltage compartment one-quarter turn using an 8 mm hexagonal key wrench. There is a pull handle provided on the right side of the low voltage compartment.
3. Slowly pull the handle so the low voltage compartment swings out. The power terminals are now visible.

The power cable access plates may require modification to suit the requirements. Use the appropriate connectors to maintain the environmental rating of the enclosure.

Figure 46 - Swing-out of low voltage compartment (heat sink and heat pipe models)

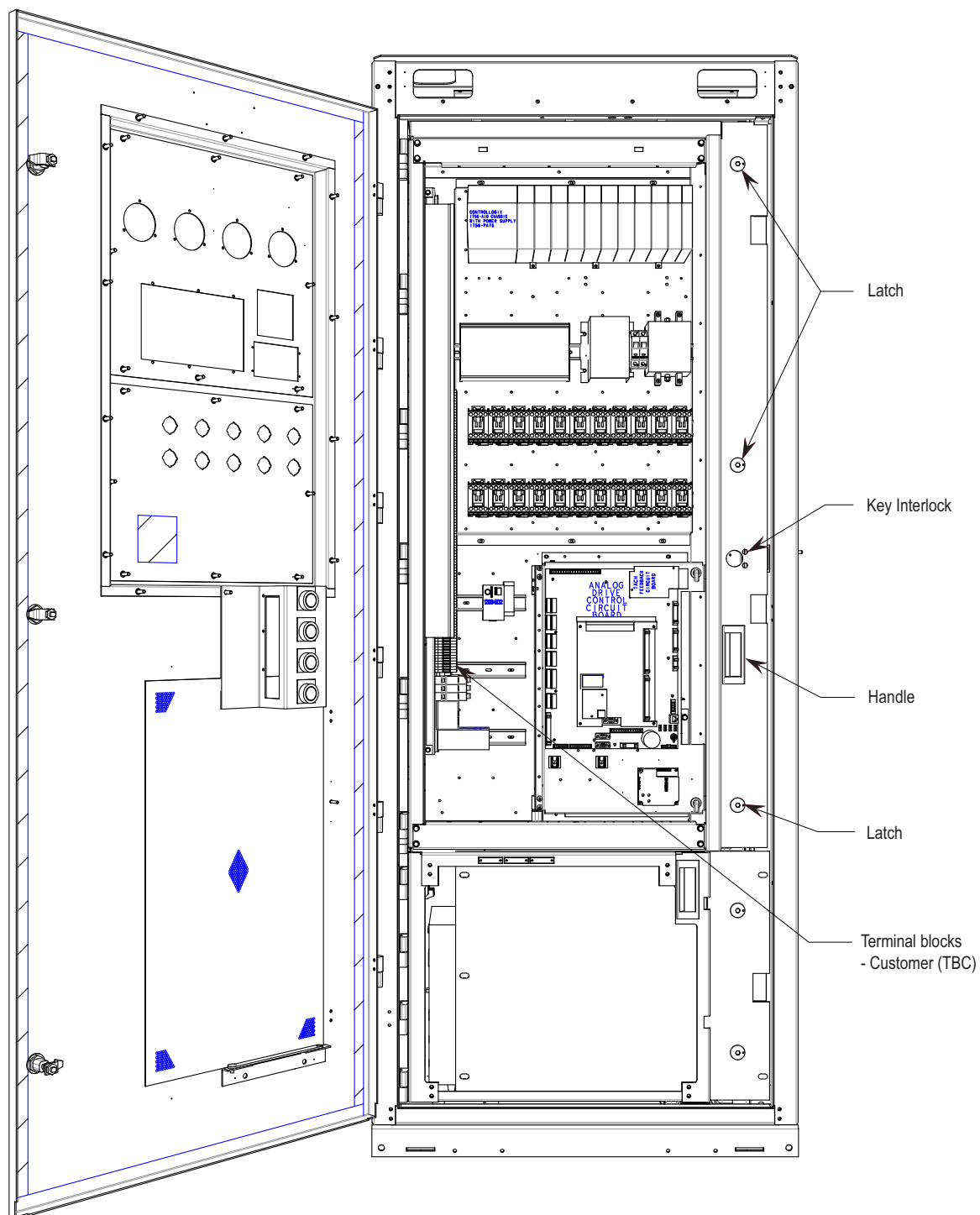


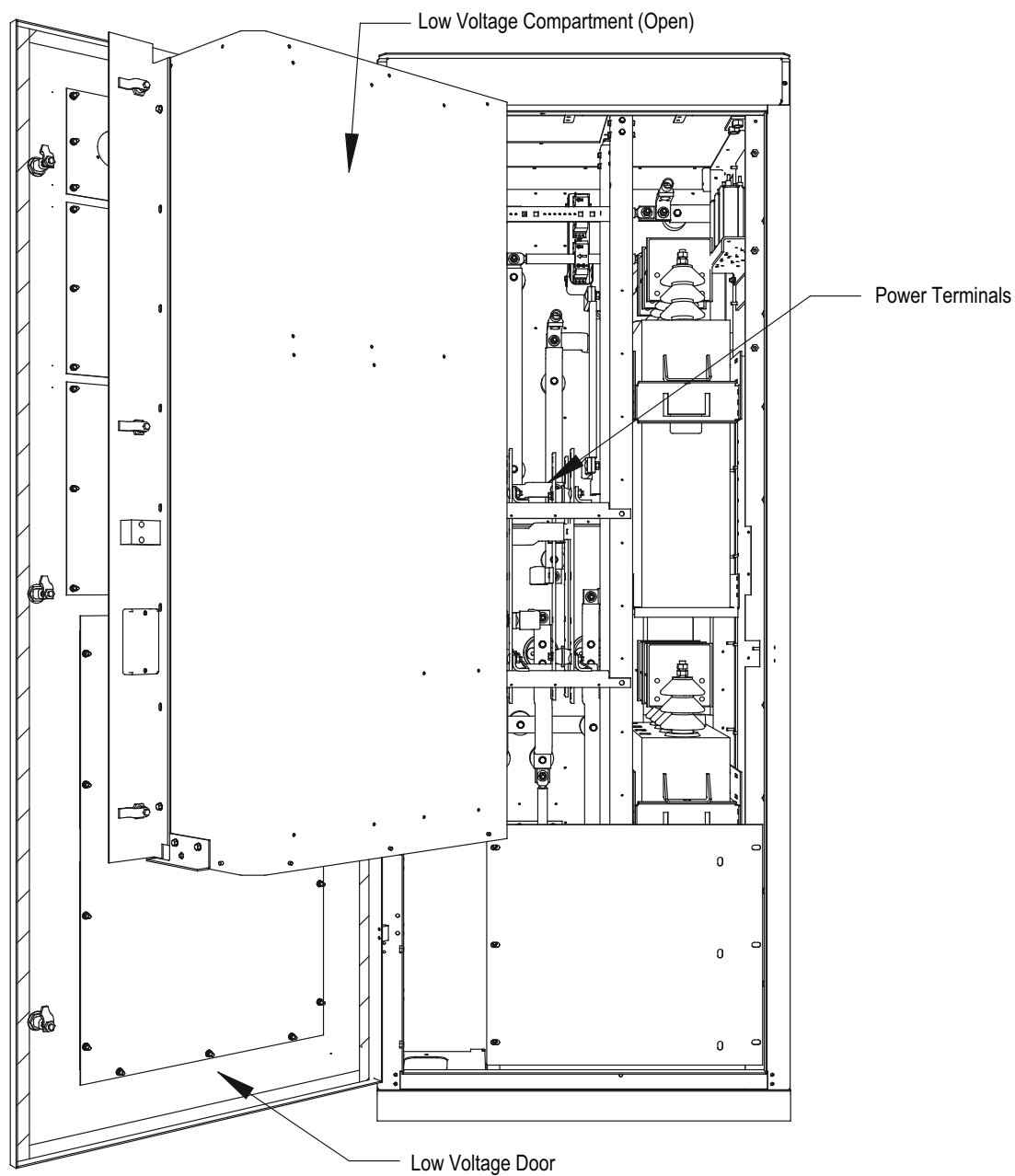
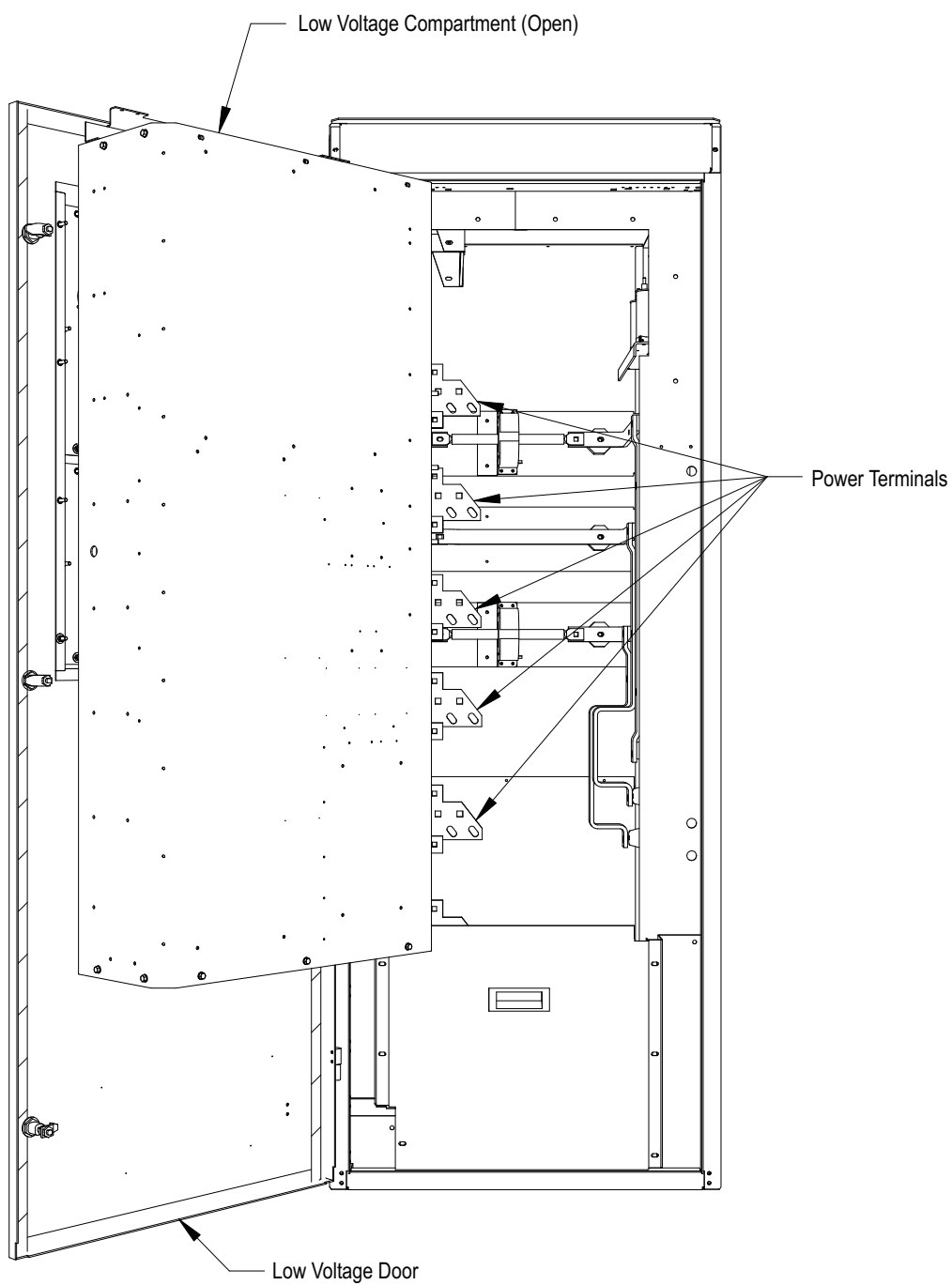
Figure 47 - Access to power terminals, AFE (heat sink model)

Figure 48 - Access to power terminals, AFE (heat pipe model)



Power Connections

Ensure that interlocking with the upstream power source is installed and functioning correctly.

Verify that all equipment power connections meet with local electrical codes.

The drive provides for cable lugs. The following table details the power terminals.

Table 4 - Incoming Connections

Drives with AFE Rectifiers:	2U, 2V, 2W
Secondary (d0)	2U, 2V, 2W
Secondary (d-20)	3U, 3V, 3W
Secondary (d+20)	4U, 4V, 4W
Motor Connections	U, V, W

Power Cabling Installation Requirements

The following drawings illustrate:

- a front view of the 900 mm input cabinet for AFE drives
- typical line cable termination assemblies (18 Pulse)

Figure 49 - Front View of 900 mm Control/Cabling Cabinet, AFE (heat pipe model)

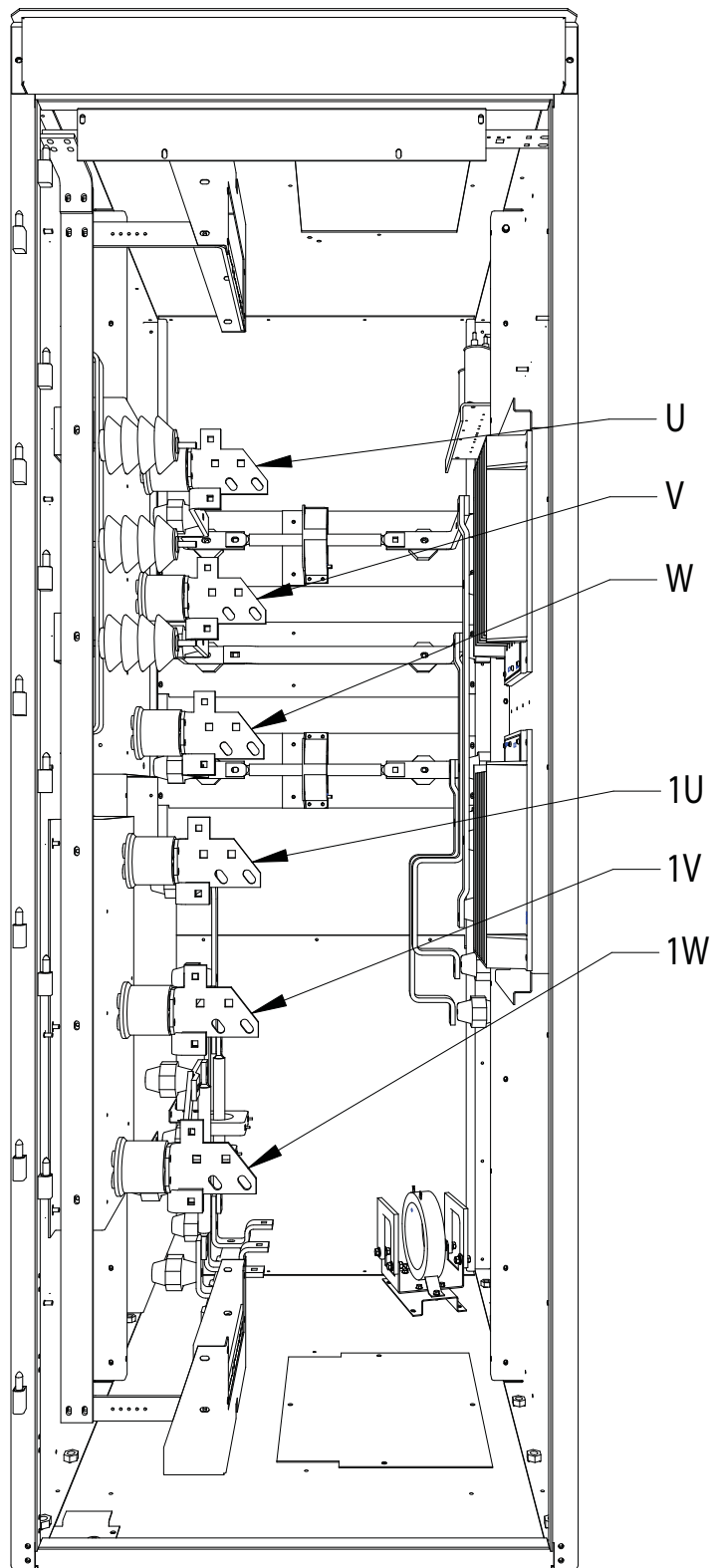
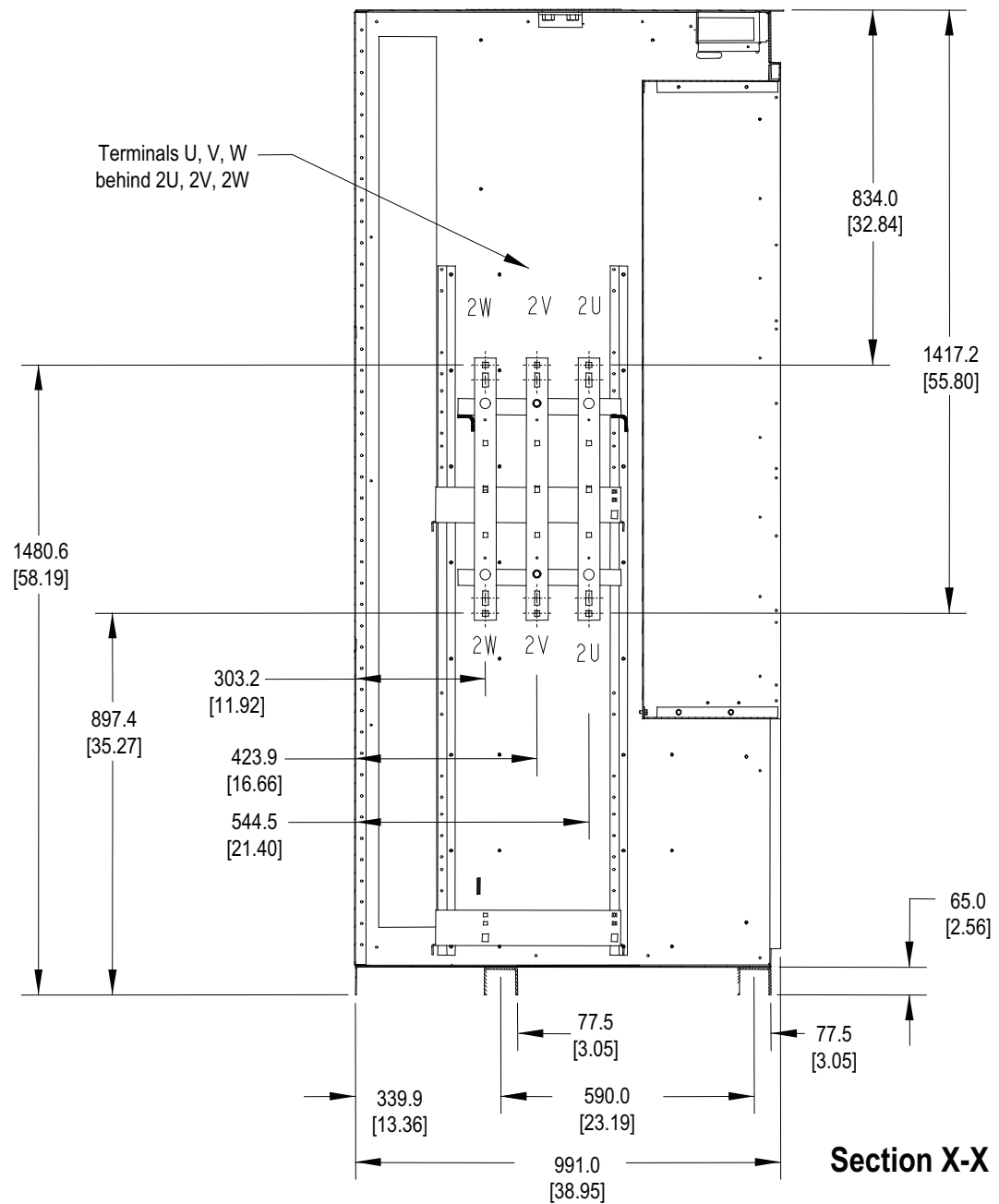


Figure 50 - Detail Power Terminal Dimensions (heat sink AFE Rectifier)

Confirm the torque applied on all power connections is correct. Refer to [Torque Requirements for Threaded Fasteners on page 73](#) for more information.

The drive provides for grounding cable shields and stress cones near the power terminals.

Power and Control Wiring

Drive line-ups (i.e. drive and input starter) shipped in two or more sections for ease of handling require reconnection for power and control wiring. After joining the sections, reconnect the power and control wiring as shown in the schematic drawings provided with the drive.

Control Cables

Locate control cable entry/exit near the terminal block 'TBC'. Route connections along the empty side of the TBC terminals. These terminals accept a maximum AWG #14 wire gauge. Connect the low voltage signals (includes 4...20 mA) using twisted shielded cable, with a minimum AWG #18 wire gauge. (Based on using a W4 terminal block for customer connections, comparable wire sizes would be 0.5...4 mm² as equivalent to #22-#10 AWG).

Two encoder inputs accommodate a quadrature encoder (senses motor direction). The encoder power supply is isolated and provides 15V and a ground reference. Many encoder outputs have an open collector output, which requires an additional pull-up resistor to feed proper signals to the system logic. (Refer to [Torque Requirements for Threaded Fasteners on page 73](#) to see if one is required).

IMPORTANT	Connect low voltage signals using twisted shielded cable, connecting the shield at the signal source end only. Wrap the shield at the other end with electrical tape and isolate it. Make connections as shown on the drawings provided.
------------------	--

Encoder Installation Guidelines

Common problems in an encoder's signal transmission to the drive include signal distortion and electrical noise. Either problem can result in a gain or loss of encoder data counts (quadrature encoders) or corrupt positional data (absolute encoders). This section provides general guidelines and recommended practices for field-installed equipment, and applies to either encoder board and both quadrature and absolute encoders.

Protection from Radiated and Conducted Noise

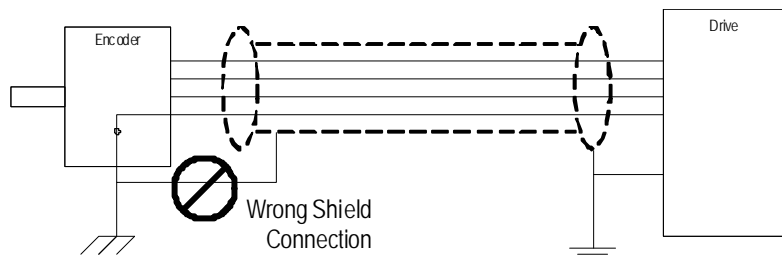
Take care when connecting and routing power and signal wiring on a machine or system. Radiated noise from nearby relays, solenoids, transformers, non-linear loads (such as motor drives) etc. can couple onto signal wires producing undesired pulses. The encoder itself may also induce noise into adjacent signal lines.

To avoid radiated and/or conducted noise, run power and signal lines separately with a minimum distance between them of at least 75 mm (3 in.). If they must overlap somewhere in the system, run the power lines at 90° to the signal lines. Signal lines should also use twisted pair shielded cable and run in separate conduit grounded to the building ground.

Encoder wires and shields should maintain continuity from the encoder to the drive. Avoid using a terminal block in a junction box. This has the potential of creating radiated noise and ground loops.

Ground the encoder case to the building ground to insure proper and reliable operation. Most encoders provide for a case ground connection through the connector/cable pair if you cannot make a ground connection through the mounting bracket/machine ground. **DO NOT** ground the encoder case through both the machine and cable wiring. Use low capacitance wires (≤ 40 pF/ft) with 100% shield coverage for long cable runs and connect the shield only at the drive end.

Figure 51 - Detail power terminal dimensions



For more protection against electrical noise, specify an encoder with complementary outputs and connect with twisted pair cable. With this type of cabling, the induced currents will self-cancel.

As a final precaution, ground the shield together with all other parts of the system that require grounding to a single point ground. This reduces varying ground potentials caused by high current fluxes from motors, remote control switches, and magnetic fields.

Signal Distortion

The primary causes of signal distortion are cable length and capacitance. The longer the cable, the greater chance of signal distortion at the receiving end. The receiving end responds to either a logical '0' or a logical '1'. Anywhere in between is undefined and the transition through this region should be $< 1.0 \mu\text{s}$. If the leading edge of the waveform is distorted it causes the transition time through this region to increase. At some point, the receiver can become unstable and either gain or lose encoder counts.

To reduce the effects of signal distortion at the encoder receiving electronics, consider the following guidelines:

1. Use a low capacitance cable ($< 120 \text{ pF/m}$ [40 pF/ft]). For example, Belden 1529 A is an 18Awg 3pair cable having a capacitance of 114 pF/m (35 pF/ft).
2. Use twisted pair cabling with a shield that covers 100% of the cable. This is especially true in the case of quadrature encoders. It is still a better choice for absolute encoders, although the data in these encoders will not exhibit the same frequency spectrum as quadrature encoders, and you can use single wire cabling. In either case, always check with the encoder manufacturer for the recommended cable.
3. Keep cable distances as short as possible. Rockwell Automation recommends the following cable lengths:
 - a. For the 20B-ENC encoders, maximum cable length is 65 m (200 ft). Longer cable distances could cause excessive surge currents. The operating frequency of the encoder has no bearing on this recommended distance due to the AC Termination. However, keeping the frequency such that the cable's characteristic impedance is $\sim 348 \Omega$ improves the surge currents and may increase the maximum distance to 100 m (330 ft).
 - b. For the Universal Encoder Interface, maximum length is 200 m (650 ft) @ 100 KHz, or to 500 m (1600 ft) at frequencies below 55 KHz. Rockwell Automation does not recommend exceeding this distance because the voltage drop across the cable can cause decreased power at the encoder.

Unused Inputs

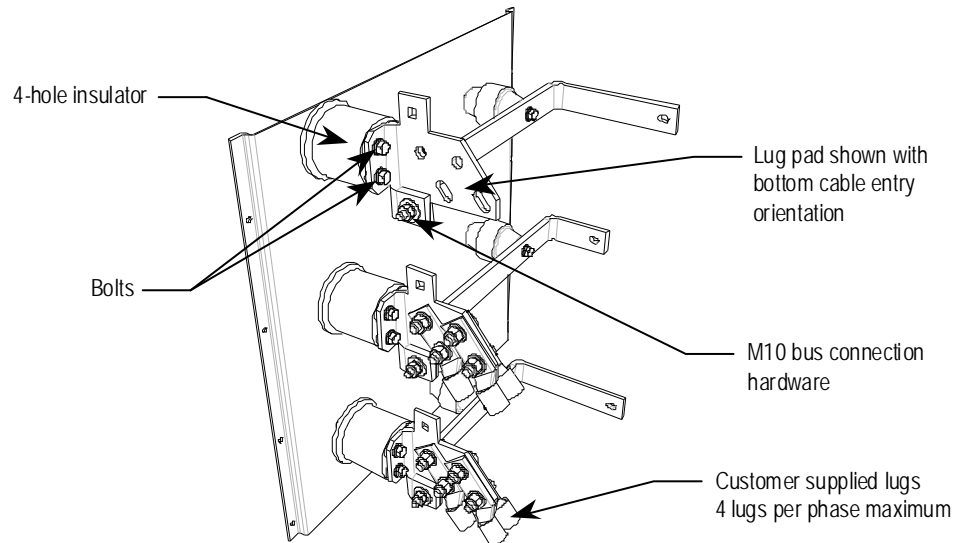
You may not require all inputs in either the quadrature or absolute encoders. For example, the absolute encoder accepts a 12-bit encoder but also works with a lower resolution. Likewise, quadrature encoders may not use the Z track. Follow these guidelines for unused inputs:

1. 20B-ENC Board. Wire any unused input to the encoder power rail. This also includes the B and B' inputs if using a pulse encoder. Failure to do this will result in phase loss warnings and improper operation of the encoder feedback logic (i.e. missing counts).
2. Universal Encode Interface. When used as a quadrature encoder interface, the same rule applies as for the 20B-ENC Board. When operating as an absolute encoder interface, the wiring of unused inputs depends on the position of the POL_QRDNT jumper. If the jumper is installed, wire all unused inputs to ENC PWR, otherwise use ENC COM.

Terminating Customer Cables

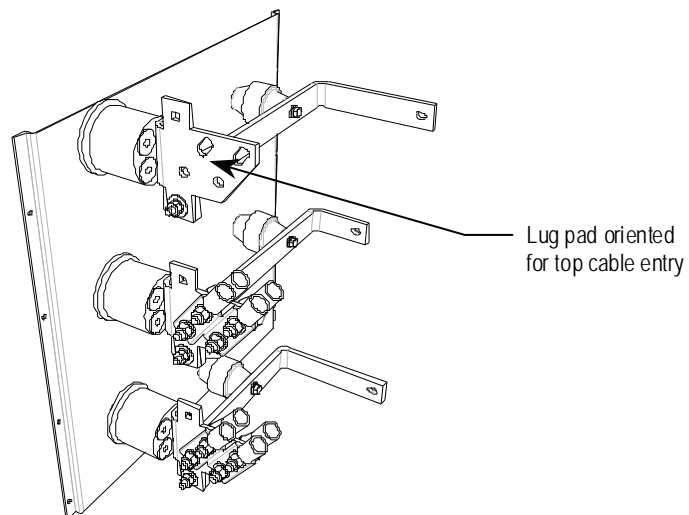
Customer termination assemblies can accommodate either top or bottom customer cable entry. For clarity, [Figure 52](#) and [Figure 53](#) show only one phase of three; there are a total of nine lug pads.

Figure 52 - Typical Line Cable Termination (shown assembled for bottom cable entry – 18 Pulse)



For top line cable entry, remove the lug pads and re-orient them as shown in [Figure 53](#). To remove the lug pads, disconnect the M10 bus connection hardware (17 mm hex tooling required). Remove the two bolts that secure the lug pad to the 4-hole insulator. Refer to [Torque Requirements for Threaded Fasteners on page 73](#) for more information regarding these electrical connections.

Figure 53 - Typical Line Cable Terminal Assembly (modified for top cable entry – 18 Pulse)



Grounding Practices

Grounding:

- increases personnel safety
- limits dangerous voltages on exposed parts with respect to ground
- facilitates proper over-current device operation under ground fault conditions, and
- provides electrical interference suppression

Generally, all external equipment grounding should meet the Canadian Electrical Code (CEC) C22.1, or the NEC NFPA 70, and applicable local codes.

Refer to the following diagrams for ground connections. Do not connect the drive's main ground bus to the system ground. This ground bus is the common ground point for all grounds internal to the drive.

Figure 54 - Ground connection diagram with isolation transformer

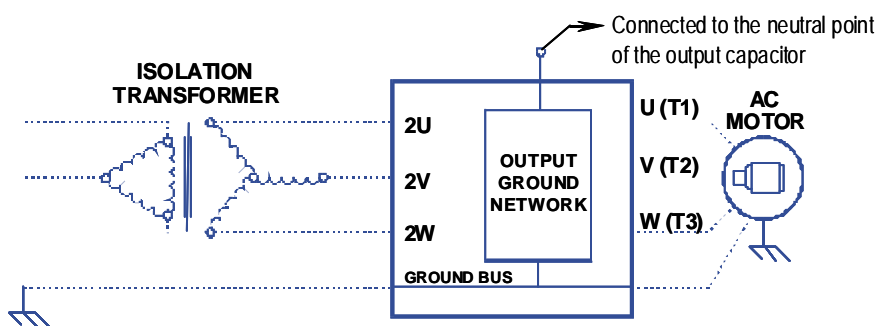
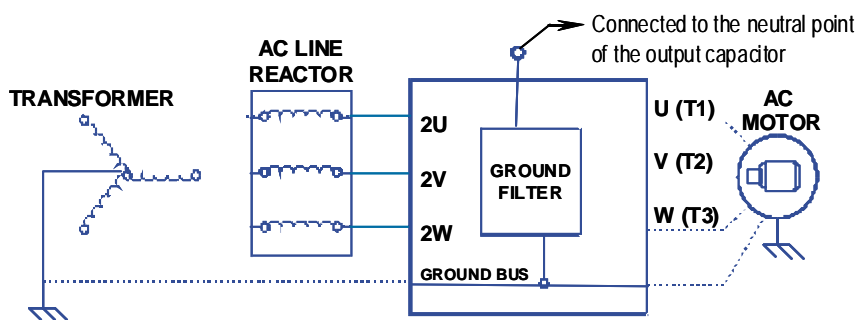


Figure 55 - Ground connection diagram with line reactor



Provide each power feeder from the substation transformer to the drive with properly sized ground cables. Using conduit or cable armor as a ground on its own is insufficient. Note that if you use a drive isolation transformer, do not ground the WYE secondary neutral point.

Bond each AC motor frame to grounded building steel within 6 m (20 ft) of its location and tie it to the drive's ground bus via ground wires within the power cables and/or conduit. The conduit or cable armor should bond to ground at both ends.

Guidelines for Drive Signal and Safety Grounds

When using interface cables carrying signals, where the frequency does not exceed 1 MHz, for communications with the drive, follow these general guidelines:

- Ground screen mesh around the entire circumference, rather than forming a pigtail grounded only at one point.
- For coaxial cables with a single conductor surrounded by a mesh screen, ground the screen at both ends.
- When using a multi-layer screened cable (that is, a cable with both a mesh screen and a metal sheath or some form of foil), there are two alternative methods:
 - Ground the mesh screen at both ends to the metal sheath. The metal sheath or foil (known as the drain) should, unless otherwise specified, be grounded at one end only, again, as specified above, at the receiver end or the end that is physically closest to the main equipment ground bus, or
 - Leave the metal sheath or foil insulated from ground, and ground the other conductors and the mesh cable screen at one end only, as stated above.

Specifications for Customers and Power Integrators

Attach an external ground to the main ground bus, in compliance with applicable local codes and standards. As general guidelines, the ground path must be of sufficiently low impedance and capacity that:

- the rise in potential of the drive ground point when subjected to a current of twice the rating of the supply should be no higher than 4V over ground potential; and,
- the current flowing into a ground fault will be of sufficient magnitude to cause the protection to operate.

Run the main grounding conductor(s) separately from power and signal wiring so that faults:

- do not damage the grounding circuit, or
- will not interfere with or damage protection or metering systems, or cause undue disturbance on power lines.

Electrical Supplies: Grounded and Ungrounded Systems

When dealing with an ungrounded, three-phase electrical supply system, the cable insulation rating must handle both the phase-to-phase voltage and the voltage-to-ground if one of the other phases develops a ground fault. In practice, the cable insulation of an ungrounded, three-phase system must be rated for at least a continuous voltage of root three (1.732) times (1.1) times the rated voltage of the supply ($1.732 \times 1.1 = 1.9$ times the rated line-to-line voltage).

Ground Bus

The drive ground bus runs along the top of the drive at the front. The ground bus is accessible at the top of each of the drive enclosures when you open the enclosure door (and the low voltage compartment hinged out in the case of the incomer cabinet). Ensure you ground the drive properly, typically at the point on the ground bus in the incomer cabinet, close to the incoming power terminations.

Interlocking

Access to the medium voltage areas of the drive is restricted by the use of key interlocking for safety.

At installation, configure the key interlocking to enable access to the medium voltage compartments only when the upstream power is locked in the OFF position.

Additionally, the key interlocking prohibits applying the upstream power until you close and lock shut the medium voltage drive's access doors.

The key interlocking must be properly installed to the upstream equipment.

Pre-Commissioning Responsibilities

Rockwell Automation manages the start-up service for each installed drive at the customer's site, but there are a number of tasks you must complete before you schedule RA personnel for drive commissioning.

This chapter outlines the required pre-commissioning responsibilities. Review this information prior to commissioning the drive as a reference for drive line-up commissioning. Record the information in the data sheets provided; these are useful during future maintenance and troubleshooting exercises.

Perform the pre-commissioning tasks in the order listed in this chapter. Failure to do so may result in equipment failure or personal injury.

IMPORTANT	Rockwell Automation requests a minimum of four weeks' notice to schedule each start-up. The standard Rockwell Automation work hours are between 9:00 AM to 5:00 PM EST, (8 hr/day) Monday through Friday, not including observed holidays. Additional working hours are available on a time and material basis.
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Inspection and Verification

Before the drive commissioning occurs, Rockwell Automation recommends the following:

1. Arranging a pre-installation meeting with Rockwell Automation personnel to review:
 - a. the start-up plan
 - b. the start-up schedule
 - c. the drive(s) installation requirements
2. Inspecting the drive's mechanical and electrical devices.
3. Performing a tug test on all internal connections within the drive and verify wiring.
4. Verifying critical mechanical connections for proper torque requirements.
5. Verifying and adjusting mechanical interlocks for permanent location.
6. Confirming all inter-sectional wiring connections.
7. Re-verifying control wiring from any external control devices, such as PLCs, etc.
8. Confirming cooling system is operational.

9. Verifying proper phasing from isolation transformer to drive.
10. Confirming drive cabling to motor, isolation transformer, and line feed.
11. Confirming test reports indicating megger / hipot test is complete on line and motor cables.
12. Control power checks to verify all system inputs such as starts/stops, faults, and other remote inputs.
13. Applying medium voltage to the drive and perform operational checks.
14. Bump motor and tune drive to the system attributes. (If the load is unable to handle any movement in the reverse direction, uncouple the load prior to bumping the motor for directional testing).
15. Running the drive motor system throughout the operational range to verify proper performance.

Note: Customer personnel must be on-site to participate in the system start-up procedures.



ATTENTION: Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of control equipment. Hazardous voltages can exist in the cabinet even with the circuit breaker in the OFF position. Rockwell Automation recommends disconnecting or locking out control equipment from power sources, and confirm discharge of stored energy in capacitors. If it is necessary to work in the vicinity of energized equipment, follow the safety related work practices of NFPA 70E, Electrical Safety Requirements for Employee Work Places.

Notwithstanding the safety references here, follow all local codes and safety practices when working on this product.



ATTENTION: The CMOS devices used on the control circuit boards are susceptible to damage or destruction by static charges. Personnel working near static sensitive devices must be appropriately grounded.

Pre-Commissioning Responsibilities

To avoid complications during commissioning, ensure that the drive line-up is ready for commissioning. This chapter includes a seven-point Pre-Commissioning Checklist. Review the checklist to ensure you complete all points in the order presented, prior to beginning the drive commissioning. Completing the checklist helps ensure that the start-up proceeds in an efficient manner.

Pre-Commissioning Checklist

Once all points of the checklist are complete, initial each check box and provide the date. Photocopy the checklist and fax the copy to Medium Voltage Support, along with the planned start-up date. Upon receiving this checklist, the Medium Voltage Support will contact the site to finalize arrangements for a start-up engineer to travel to the site at your convenience.

Please print the following information:

Medium Voltage Support	Name:	Date:
Rockwell Automation	Company:	
Fax: 1 (866) 465-0103 or Fax: 1 (519) 740-4756	Phone:	Pages:
	Fax:	
Drive Serial Number:		
CSM Service Engineer Requested (YES/NO):		
Scheduled Commissioning Date:		

Table 5 - Receiving and Unpacking:

Initials	Date	Check	
			The drives have been checked for shipping damage upon receiving.
			After unpacking, the item(s) received are verified against the bill of materials.
			Any claims for breakage or damage, whether concealed or obvious, are made to the carrier by the customer as soon as possible after receipt of shipment.
			All packing material, wedges, or braces are removed from the drive.

Table 6 - Installation and Mounting:

Initials	Date	Check	
			The drive is securely fastened in an upright position, on a level surface. Seismic zones require special fastenings. Consult factory.
			Lifting Angles have been removed.
			Bolts have been inserted into original location on top of drive (leakage of cooling air).
			All contactors and relays have been operated manually to verify free movement.

Table 7 - Safety:

Initials	Date	Check	
			All mechanical interlocks and door Ram Interlocks are tested for proper functionality and are not defeated or damaged.
			All Kirk key interlocks are installed and tested for proper functionality.
			The grounding of the drive should be in accordance with CEC, NEC, or IEC regulations.

Initials	Date	Check	
			If the drive has an isolation transformer, the transformer enclosure and/or frame must be bonded to system ground at a minimum of two locations.
			If the drive has an isolation transformer, the wye secondary neutral point must not be grounded.
			If shipping splits exist in the line-up, the ground bus between cabinets has been installed.
			Based on your local regulation, an ARC Flash study has been completed.

Table 8 - Control Wiring:

Initials	Date	Check	
			All low voltage wiring entering the drive is labeled, appropriate wiring diagrams are available, and all customer interconnections are complete.
			If an encoder is used, the encoder must be isolated from the motor frame. The encoder cables should be routed in grounded steel conduit for electrical noise suppression, and the conduit must be grounded at junction box but left isolated from the encoder with an insulated bushing.
			The encoder cable shield to the drive is connected to the ground bus at the drive end only.
			All AC and DC circuits are run in separate conduits.
			All wire sizes used are selected by observing all applicable safety and CEC / NEC / IEC regulations.
			Remote I/O Interface is properly configured / active.
			All 3-phase control wiring is within specified levels and has been verified for proper rotation, UVW.
			All single-phase control wiring is within specified levels and has grounded neutrals.

Table 9 - Power Wiring:

Initials	Date	Check	
			The power cable connections to the drive, motor and isolation transformer adhere to CEC, NEC, IEC or appropriate local standards.
			The cable terminations, if stress cones are used, adhere to the appropriate standards.
			Appropriate cable insulation levels are adhered to, as per Rockwell Automation specifications (refer to Cable Insulation on page 37).
			All shields for shielded cables must be grounded at the source end only.
			If shielded cables are spliced, the shield must remain continuous and insulated from ground.
			All wire sizes used are selected by observing all applicable safety and CEC / NEC / IEC regulations.

Initials	Date	Check	
			All power connections are torqued as per Rockwell Automation specifications. Refer to Torque Requirements for Threaded Fasteners on page 73 .
			All customer power cabling has been meggered or hi-pot tested before connecting to drive system.
			Power wiring phase rotation has been verified per the specific electrical diagrams supplied by Rockwell Automation.

Table 10 - Drive Line-up Status

Initials	Date	Check	
			The medium voltage and low voltage power is available for startup activities.
			The motor is uncoupled from the driven load.
			The load is available for full load testing.

[illegible]

Additional Required Resources

Prior to scheduling your drive commission, ensure you have the following:

- Self-powered gate driver board test power cable wire harness (Part no. 80018-298-51) supplied with SCR rectifier drives only
- Rockwell Automation electrical and mechanical diagrams for each drive
- PLC program (if supplied with a PLC)
- Commissioning data sheets
- All required manuals (see below for list)

If any of the above information is not available prior to the time of commissioning, please contact the factory.

Technical Publications and Manuals

Each drive ships with a service binder containing all technical publications required to install, use, and troubleshoot the drive line-up. This section describes how to determine what technical publications are required and how to obtain them in the event that the service binder is not available when pre-commissioning, or when you require additional information:

The PowerFlex 7000 “B” Frame Commissioning Manual, Publication [7000-IN012_-EN-P](#): This is a Rockwell Automation-internal document for commissioning engineers conducting commissioning procedures. Customers can request copies of the manual from their local Rockwell Automation Office.

The PowerFlex 7000 Technical Data publication: Use this document for parameter details and programming during commissioning or troubleshooting. Refer to [7000-TD002_-EN-P](#) for the latest firmware revision.

The PowerFlex 7000 “B” Frame User Manual, Publication [7000-UM202_-EN-P](#): Use this document for general information regarding the usage and programming of the operator interface after installation (before or after commissioning.)

Additional Manuals: The electrical schematics that ship with the drive should list any additional manual necessary for configuring the drive line-up. The schematic titled “General Notes” identifies all required Rockwell Automation publications by publication number.

Notes:

General Reference

Torque Requirements for Threaded Fasteners

Unless otherwise specified, use the following values of torque in maintaining the equipment.

Diameter	Pitch	Material	Torque (N·m)	Torque (lb·ft)
M2.5	0.45	Steel	0.43	0.32
M4	0.70	Steel	1.8	1.3
M5	0.80	Steel	3.4	2.5
M6	1.00	Steel	6.0	4.4
M8	1.25	Steel	14	11
M10	1.50	Steel	29	21
M12	1.75	Steel	50	37
M14	2.00	Steel	81	60
1/4"	20	Steel S.A.E. 5	12	9.0
3/8"	16	Steel S.A.E. 2l	27	20

Preventative Maintenance Schedule

Rockwell Automation recognizes that following a defined maintenance schedule improves your drive's performance and operational lifespan. By rigorously following this maintenance schedule, you can expect the highest possible uptime. Annual maintenance includes a visual inspection of all drive components visible from the front of the unit, resistance checks on the power components, power supply voltage level checks, general cleaning and maintenance, checking of all accessible power connections for tightness, and other tasks. These tasks are described in detail in publication [7000-UM202-EN-P](#).

I – Inspection	This indicates that the component should be inspected for signs of excessive accumulation of dust/dirt/etc. or external damage (e.g. looking at Filter Capacitors for bulges in the case, inspecting the heat sinks for debris clogging the air flow path, etc.).
M – Maintenance	This indicates a maintenance task that is outside the normal preventative maintenance tasks, and can include the inductance testing of Line Reactors/DC Links, or the full testing of an isolation transformer.
R – Replacement	This indicates that the component has reached its mean operational life, and should be replaced to decrease the chance of component failure. It is very likely that components will exceed the design life in the drive, and that is dependent on many factors such as usage, heating, etc.
C – Cleaning	This indicates the cleaning of a part that can be reused, and refers specifically to the door-mounted air filters in the liquid-cooled drives and some air-cooled drives.
Rv – Review	This refers to a discussion with Rockwell Automation to determine whether any of the enhancements/changes made to the Drive Hardware and Control would be valuable to the application.
RFB/R – Refurbishment/Replacement	The parts can be refurbished at lower cost OR the parts can be replaced with new ones.

Encoder Usage

When is an Encoder Required?

An encoder is required under the following conditions:

1. When speed regulation accuracy must be between 0.01...0.02% of nominal speed.
2. When the zero speed breakaway torque needed is greater than 90% of continuous running torque.
3. When continuous running speed is greater than or equal to 0.1 Hz, but less than 6 Hz.
4. For minimizing restart times using the flying start capability in forward or reverse direction.
5. At any time when high performance torque or speed control mode (HPTC) is enabled.

Table 11 - PowerFlex Speed Regulation

Encoder	Frequency Output		
	<6 Hz	6...15 Hz	>15 Hz
Without Encoder	Not applicable	0.1%	0.1%
With Encoder	0.02%	0.01%	0.01%
With Encoder and HPTC mode enabled	0.01%	0.01%	0.01%

Notes:

- Speed regulation is based on a percentage of motor synchronous speed.
- Encoder to be mounted on the AC machine
- Operational 15V DC Power Supply mounted in drive to power the encoder as a standard option with the encoder feed back card.
- Customer is responsible for providing and mounting of encoder
- Sleeve bearing motors require the encoder to have an axial movement tolerance.
- Recommended encoders are shaft mounting type.
- Magneto resistive models are more adaptable to harsh environments.
- When installing, the encoder body and electronics must be isolated from ground (options available from the encoder manufacturer to accomplish this).
- There are usually limits on encoder cable lengths. Ensure the maximum length is suitable for the application.

Table 12 - Encoder Selection

High Performance Torque Control (HPTC) Mode	Motor RPM	Minimum Tach PPR	Recommended Tach PPR
	3600	1024	1024
	3000	1024	1024
	1800	1024	2048
	1500	1024	2048
	1200	2048	2048
	1000	2048	2048
	900	2048	4096
	720	4096	4096
	600	4096	4096
	450	4096	8192
	360	8192	8192
	300	8192	8192

Table 12 - Encoder Selection (Continued)

Standard Control Mode	3600	—	600
	3000	—	600
	1800	—	1024
	1500	—	1024
	1200	—	2048
	1000	—	2048
	900	—	2048
	720	—	2048
	600	—	2048

PowerFlex 7000 Drive Performance (Torque Capabilities)

The PowerFlex 7000 drives have been tested on a dynamometer to verify performance under locked rotor, accelerating, and low speed-high torque conditions. [Table 13](#) shows the PowerFlex 7000 drive torque capabilities as a percent of motor rated torque, independent of the drive's momentary overload conditions.

Table 13 - PowerFlex 7000 Drive Torque Capabilities

Parameter	7000 Torque Capability without Encoder (% of Motor Rated Torque)	7000 Torque Capability with Encoder (% of Motor Rated Torque)	7000 Torque Capability with Encoder and High Performance Torque Control (HPTC)
Breakaway Torque	90%	150%	150%
Accelerating Torque	90% (0...8 Hz)	140% (0...8 Hz)	150% (0...75 Hz)
	125% (9...75 Hz)	140% (9...75 Hz)	
Steady State Torque	125% (9...75 Hz) ⁽¹⁾	100% (1...2 Hz)	150% (0...60 Hz) ⁽¹⁾
		140% (3...60 Hz) ⁽¹⁾	
Max. Torque Limit	150%	150%	150%

(1) Drive will require over-sizing to achieve greater than 100% continuous torque.

Glossary of Terms

Breakaway Torque: Torque required to start a machine from standstill.

Accelerating Torque: Torque required to accelerate a load to a given speed, in a certain period of time. The following formula may be used to calculate the average torque to accelerate a known inertia (WK^2):

$$T = (WK^2 \times \text{change in RPM}) / 308t$$

where:

- T = acceleration torque in $N \bullet m$ ($lb \bullet ft$)
- W = force N or kgf (lb)
- K = gyration radius m (ft)
- WK^2 = total system inertia ($kgf \times m^2$ [$lb \bullet ft^2$]) that the motor must accelerate, including motor, gear box, and load
- t = time (s) to accelerate total system load

Steady State Torque: Continuous operating torque required to control the load, without instability.

Torque Limit: An electronic method of limiting the maximum torque available from the motor. The software in a drive typically sets the torque limit to 150% of motor rated torque.

Table 14 - Typical Application Load Torque Profiles

Table 15 - Typical Application Load Torque Profiles⁽¹⁾

Application	Load Torque Profile	Load Torque as Percent of Full-Load Drive Torque			Required Drive Service Duty Rating	Encoder Required for Extra Starting Torque?
		Break-away	Accelerating	Peak Running		
AGITATORS						
Liquid	CT	100	100	100	Heavy	Yes
Slurry	CT	150	100	100	Heavy	Yes
BLOWERS (centrifugal)						
Damper closed	VT	30	50	40	Normal	No
Damper opened	VT	40	110	100	Normal	No
CHIPPER (WOOD)—starting empty	CT	50	40	200	Contact factory	No
COMPRESSORS						
Axial-vane, loaded	VT	40	100	100	Normal	No
Reciprocating, starting unloaded	CT	100	100	100	Contact factory	Yes
CONVEYORS						
Armored face	CT	175	150	200	Contact factory	Yes
Belt type, loaded	CT	150	130	100	Heavy	Yes
Drag type	CT	175	150	100	Contact factory	Yes
Screw type, loaded	CT	200	100	100	Contact factory	Yes
DRAG LINE	CT	100	200	200	Contact factory	Yes

Table 15 - Typical Application Load Torque Profiles (Continued)⁽¹⁾

Application	Load Torque Profile	Load Torque as Percent of Full-Load Drive Torque			Required Drive Service Duty Rating	Encoder Required for Extra Starting Torque?
		Break-away	Accelerating	Peak Running		
EXTRUDERS (rubber or plastic)	CT	150	150	100	Contact factory	Yes
FANS (centrifugal, ambient)						
Damper closed	VT	25	60	50	Normal	No
Damper open	VT	25	110	100	Normal	No
FANS (centrifugal, hot gases)						
Damper closed	VT	25	60	100	Normal	No
Damper open	VT	25	200	175	Contact factory	No
FANS (propeller, axial flow)	VT	40	110	100	Normal	No
GRINDING MILL (Ball/Sag Mill)	CT	175	180	100	Contact factory	Yes
HOISTS	CT	100	200	200	Contact factory	Yes
KILNS (rotary, loaded)	CT	250	125	125	Contact factory	Yes
MIXERS						
Chemical	CT	175	75	100	Contact factory	Yes
Liquid	CT	100	100	100	Heavy	Yes
Slurry	CT	150	125	100	Heavy	Yes
Solids	CT	175	125	175	Contact factory	Yes
PULPER	VT	40	100	150	Contact factory	No
PUMPS						
Centrifugal, discharge open	VT	40	100	100	Normal	No
Oil field Flywheel	CT	150	200	200	Contact Factory	Yes
Propeller	VT	40	100	100	Normal	No
Fan Pump	VT	40	100	100	Normal	No
Reciprocating / Positive Displacement	CT	175	30	175	Contact factory	Yes
Screw type, started dry	VT	75	30	100	Normal	No
Screw type, primed, discharge open	CT	150	100	1000	Heavy	Yes
Slurry handling, discharge open	CT	150	100	100	Heavy	Yes
Turbine, Centrifugal, deep-well	VT	50	100	100	Normal	No
Vane-type, positive displacement	CT	150	150	175	Contact factory	Yes
SEPARATORS, AIR (fan type)	VT	40	100	100	Normal	No

(1) PowerFlex 7000 "A" Frame suitable only for normal service duty rating.

Meggering

Drive Meggering

When a ground fault occurs, there are three zones in which the problem may appear: input to the drive, the drive, output to the motor. The ground fault condition indicates a phase conductor has found a path to ground. Depending on the resistance of the path to ground, a current with magnitude ranging from leakage to fault level exists. Based on our experiences in drive systems, the highest probability for the source of the fault exists in either the input or output zones. The drive itself rarely has been a source of a ground fault when it is properly installed. This is not to say there will never be any ground fault problems associated with the drive, but the chances are the fault is outside of the drive. Also, the procedure for meggering the drive is more complex than meggering outside the drive.

With these two factors, it is recommended to first megger the input and output zones when encountering a ground fault. If the location of the ground fault can not be located outside the drive, the drive will need to be meggered. This procedure must be performed with due care as the hazards to drive exist if the safety precautions in the procedure are not followed. This is due to the fact the megger procedure applies high voltage to ground: all the control boards in the drive have been grounded and if not isolated, they will have high potential applied to them causing immediate damage.

Meggering the PowerFlex 7000



ATTENTION: Use caution when performing a Megger test. High voltage testing is potentially hazardous and may cause severe burns, injury or death. Where appropriate, connect the test equipment to ground.

Ensure you check the insulation levels before energizing power equipment. Megger tests provide a resistance measurement from the phase-to-phase and phase-to-ground by applying a high voltage to the power circuitry. Perform this test to detect ground faults without damaging any drive equipment.

This test involves “floating” the drive and all connected equipment to a high potential while measuring the leakage current to ground. Floating the drive means to temporarily remove any existing paths to ground necessary for normal operation of the drive.



ATTENTION: There are risks of serious or fatal injury to personnel if you do not follow safety guidelines.

Following this procedure to perform Megger tests on the PowerFlex 7000B. Failure to comply with this procedure may result in poor Megger reading and damage to drive control boards.

Meggering Procedures

Required Equipment

- Torque Wrench and 7/16 in. socket
- Phillips Screwdriver
- 2500/5000V Megger

Procedure

1. Isolate and lock out the drive system from any high voltage source.

Disconnect any incoming power sources, medium voltage sources should be isolated and locked out and all control power sources should be turned off at their respective circuit breaker(s).

Verify with a potential indicator that power sources have been disconnected, and that the control power in the drive is de-energized.

2. Isolate the power circuit from system ground ("float the drive").

Remove the grounds on the following components within the drive (refer to the electrical diagrams provided with the equipment to assist in determining the points to disconnect):

- Voltage Sensing Boards (VSB)
- Output Grounding Network (OGN)

Voltage Sensing Boards

- a. Remove all ground connections from all of the VSBs in the drive. Do this at the screw terminals on the VSB rather than the ground bus. There are two grounds on each board marked "GND 1", and "GND 2".

Note: It is important to disconnect the terminals on the boards rather than from the ground bus as the grounding cable is only rated for 600V. Injecting a high voltage on the ground cable will degrade the cable insulation. Do not disconnect the white medium voltage wires from the VSBs. They must be included in the test.

The number of VSBs installed in each drive varies depending on the drive configuration.

Output Grounding Network

- b. Remove the ground connection on the OGN (if installed). Lift this connection at the OGN capacitor rather than the grounding bus, as the grounding cable is only rated for 600V.

Note: Injecting a high voltage on the ground cable during a Megger test will degrade the cable insulation.

3. Disconnect connections between power circuit and low voltage control.

Voltage Sensing Boards

The connections between the low voltage control and the power circuit are made through ribbon cable connectors. The cables are plugged into connectors on the voltage sensing board marked “J1”, “J2”, and “J3”, and terminate on the signal conditioning boards. Every ribbon cable connection made on the VSBs should be marked for identification from the factory.

- a. Confirm the marking matches the connections, and disconnect the ribbon cables and move them clear of the VSB. If you do not remove these ribbon cables from the VSB, then high potential applies directly to the low voltage control through the SCBs, causing immediate damage to those boards.

Note: The VSB ribbon cable insulation is not rated for the potential applied during a Megger test. You must disconnect the ribbon cables at the VSB rather than the SCB to avoid exposing the ribbon cables to high potential.

Potential Transformer Fuses

A Megger test may exceed the rating of potential transformer fusing. Removing the primary fuses from all potential and control power transformers in the system not only protects them from damage, but removes a path from the power circuit back to the drive control.

Transient Suppression Network

A path to ground exists through the TSN network as it has a ground connection to dissipate high energy surges in normal operation. If this ground connection is not isolated, the Megger test will indicate a high leakage current reading through this path, falsely indicating a problem in the drive. To isolate this ground path, all fuses on the TSN must be removed before proceeding with the Megger test.

Surge Arrestors

Drives supplied after 2009 will have surge arrestors instead of a TSN. Surge arrestors can remain in the circuit during the meggering procedure.

4. Megger the drive.

Note: Verify the drive and any connected equipment is clear of personnel and tools prior to commencing the Megger test. Barricade any open or exposed conductors. Conduct a walk-around inspection before commencing the test.

All three phases on the line and machine sides of the drive connect through the DC Link and snubber network. Therefore, a test from any one of the input or output terminals to ground will provide all the sufficient testing required for the drive.



ATTENTION: Discharge the Megger prior to disconnecting it from the equipment.

- a. Connect the Megger to the drive following the specific instructions for that model.
- b. If the Megger has a lower voltage setting (normally 500V or 1000V), apply that voltage for five seconds as a precursor for the higher voltage rating. This may limit the damage if you forgot to remove any grounds. If the reading is very high, apply 5 kV from any drive input or output terminal to ground.
- c. Perform a Megger test at 5 kV for one minute and record the result.

The test should produce a reading greater than the minimum values listed below. If the test results produced a value lower than these values, segment the drive system into smaller components and repeat the test on each segment to identify the source of the ground fault. This implies isolating the line side of the drive from the machine side by removing the appropriate cables on the DC Link reactor.

You may need to completely isolate the DC Link reactor from the drive, at which point you must disconnect all four power cables. Ensure all electrical components to be meggered are electrically isolated from ground.

Items that may produce lower than expected readings are surge capacitors at the motor terminals, motor filter capacitors at the output of the drive. The meggering procedure must follow a systematic segmentation of electrical components to isolate and locate a ground fault.

Type of Drive	Minimum Megger Value
Liquid-cooled Drive	200 MΩ
Air-cooled Drive	1k MΩ
Drive with input/output Caps Disconnected	5k MΩ
Isolation Transformer	5k MΩ
Motor	5k MΩ

The motor filter capacitors and line filter capacitors (if applicable) may result in the Megger test result being lower than expected. These capacitors have internal discharge resistors designed to discharge the capacitors to ground. If you are uncertain of the Megger test results, disconnect the output capacitors.

IMPORTANT Humidity and dirty standoff insulators can cause leakage to ground because of tracking. You may have to clean a 'dirty' drive prior to commencing the Megger test.

5. Reconnect connections between power circuit and low voltage control.

Reconnect the ribbon cables “J1”, “J2” and “J3” in all the VSBs. Do not cross the cable connections. Mixing the feedback cables may result in serious damage to the drive.

6. Reconnect the power circuit to the system ground.

Voltage Sensing Boards

a. Securely reconnect the two ground conductors on the VSBs.

The two ground connections on the VSB provide a reference point for the VSB and enable the low voltage signal to be fed to the SCBs. If you do not connect the ground conductor, the monitored low voltage signal could then rise up to medium voltage potential, which is a serious hazard to avoid at all times. Always ensure the ground conductors on the VSB are securely connected before applying medium voltage to the drive.

Failure to connect both ground connections on the voltage sensing board will result in high potential in the low voltage cabinet within the drive that will damage the drive control, and possible cause injury or death to personnel.

Output Grounding Network

b. Reconnect the ground connection on the OGN capacitor. The bolt connection should torque down to 3.4 N•m (30 lb•in.). Exceeding the torque rating of this connection may result in damage to the capacitor.

Failure to reconnect the OGN ground may result in impressing the neutral voltage offset on the motor cables and stator, which may result in equipment damage. For drives that did not originally have the OGN connected (or even installed), this is not a concern.

Transient Suppression Network

c. Re-install the fuses on the TSN.

Notes:

Line & Load Cable Sizes

Max. Line Cable Sizes

PRODUCT					INPUT (LINE SIDE)			
Bulletin		Description (V/Freq./Rect.)	Drive rating (A)	Drive Structure Code	Drive Enclosure Opening Inches (mm) ¹	Max. Size & No. Incoming Cables: NEMA 2-4-5-6-8-9	Max. Size & No. Incoming Cables: IEC 2-4-5-6-8-9	Vertical Space Avail. for Stress Cones Inches (mm)
'A' Frame (Air-Cooled)	PF7000A	2400V/60Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.8 (478)
	PF7000A	2400V/60Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	17.1 (435)
	PF7000A	3300V/50Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.8 (478)
	PF7000A	3300V/50Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	17.1 (435)
	PF7000A	4160V/50Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.8 (478)
	PF7000A	4160V/50Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	17.1 (435)
	PF7000A	4160V/60Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18-3/8 (467)
	PF7000A	4160V/60Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	17.1 (435)
	PF7000A	6600V/50Hz/RPDTD	40...93	71.10 w/ starter	4.00x4.00 (102x102)	(1) #4/0 8 kV or 15 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.8 (478)
	PF7000A	6600V/50Hz RPDTD	40...93	71.14, 71.19 w/o starter	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	17.1 (435)
	PF7000A	2400V/60Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	33.8 (860)
	PF7000A	3300V/50Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	33.8 (860)
	PF7000A	4160/50Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	33.8 (860)
	PF7000A	4160/60Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	33.8 (860)
	PF7000A	6600/50Hz/RPTX	40...105	71.8	4.00x8.00 (102x204) ¹	(1) 350MCM 15 kV/phase	(1) 177mm ² 15 kV/phase	33.8 (860)
	PF7000A	2400V/60Hz/RPTXI	46...160	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.0 (508) ³
	PF7000A	3300V/50Hz/RPTXI	46...160	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.0 (508) ³
	PF7000A	4160V/50Hz/RPTXI	46...140	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.0 (508) ³
	PF7000A	4160V/60Hz/RPTXI	46...160	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.0 (508) ³
	PF7000A	6600V/50Hz/RPTXI	40...105	71.6, 71.15	4.00x4.00 (102x102)	(1) #4/0 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	20.0 (508) ³

PRODUCT				INPUT (LINE SIDE)				
Bulletin		Description (V/Freq./Rect.)	Drive rating (A)	Drive Structure Code	Drive Enclosure Opening Inches (mm) ¹	Max. Size & No. Incoming Cables: NEMA 2-4-5-6-8-9	Max. Size & No. Incoming Cables: IEC 2-4-5-6-8-9	Vertical Space Avail. for Stress Cones Inches (mm)
'B' Frame (Air-Cooled)	PF7000	2400V/60Hz/RPDTD	46...430	70.40, 70.41, 70.44, 70.45	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	2400V/60Hz/RPDTD	46...375	70.40C, 70.41C, 70.44C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV or 8kV/phase	(1) 253mm ² 5kV or 8kV/phase	34.4 (874)
	PF7000	3300V/50Hz/RPDTD	46...430	70.43, 70.44, 70.45, 70.47	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	3300V/50Hz/RPDTD	E495-E625, G285, G325, N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.5 (421)
	PF7000	3300V/50Hz/RPDTD	46...375	70.43C, 70.44C, 70.45C, 70.47C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV or 8kV/phase	(1) 253mm ² 5kV or 8kV/phase	34.4 (874)
	PF7000	4160V/50Hz/RPDTD	46...375	70.43, 70.44, 70.45, 70.47	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	4160V/50Hz/RPDTD	46...375	70.43C, 70.44C, 70.45C, 70.47C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV or 8kV/phase	(1) 253mm ² 5kV or 8kV/phase	34.4 (874)
	PF7000	4160V/60Hz/RPDTD	46...430	70.43, 70.44, 70.45, 70.47	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 8kV or 15kV/phase	28.5 (725)
	PF7000	4160V/60Hz/RPDTD	E495-E625, G285, G325 N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.5 (421)
	PF7000	4160V/60Hz/RPDTD	46...375	70.43C, 70.44C, 70.45C, 70.47C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV or 8kV/phase	(1) 253mm ² 8kV or 15kV/phase	34.4 (874)
	PF7000	6600V/50Hz/RPDTD	46...285	70.46, 70.47, 70.48, 70.49	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 8kV or 15kV/phase	28.5 (725)
	PF7000	6600V/50Hz/RPDTD	E325-E575, G215, G250 N625	70.34, 70.35	12.79x19.68 (325x500) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 8kV or 15kV/phase	16.5 (421)
	PF7000	6600V/50Hz/RPDTD	40...285	70.46C, 70.47C, 70.49C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 8kV or 15kV/phase	(1) 253mm ² 8kV or 15kV/phase	34.4 (874)
	PF7000	6600V/60Hz/RPDTD	40...285	70.46, 70.47, 70.48, 70.49	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	6600V/60Hz/RPDTD	40...285	70.46C, 70.47C, 70.49C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 8kV or 15kV/phase	(1) 253mm ² 5kV or 8kV/phase	34.4 (874)
	PF7000	2400V/60Hz/RPTX	46...430	70.1, 70.2, 70.25, 70.26	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	3300V/50Hz/RPTX	46...430	70.10, 70.27, 70.28, 70.30	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	3300V/50Hz/RPTX	E495-E625, G285, G325 N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.5 (421)
	PF7000	4160V/50Hz/RPTX	46...430	70.10, 70.27, 70.29, 70.30	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	4160V/60Hz/RPTX	46...430	70.2, 70.26, 70.27, 70.28, 70.29, 70.31	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)

PRODUCT					INPUT (LINE SIDE)			
Bulletin		Description (V/Freq./Rect.)	Drive rating (A)	Drive Structure Code	Drive Enclosure Opening Inches (mm) ¹	Max. Size & No. Incoming Cables: NEMA 2-4-5-6-8-9	Max. Size & No. Incoming Cables: IEC 2-4-5-6-8-9	Vertical Space Avail. for Stress Cones Inches (mm)
'B' Frame (Air-Cooled) cont'd.	PF7000	4160V/60Hz/RPTX	E495-E625 G285, G325 N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.5 (421)
	PF7000	6600V/50Hz/RPTX	40...285	70.11, 70.28, 70.30, 70.31	9.79x10.97 (249x279) ¹	(2) 500MCM 15kV/phase	(2) 127mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	6600V/50Hz/RPTX	E325-E575 G215, G250 N625	70.36, 70.37	12.79x19.68 (325x500) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 8kV or 15kV/phase	16.5 (421)
'C' Frame (Liquid-Cooled)	PF7000	2400V/60Hz/RP18TX ⁷	46...430	70.8	9.79x21.06 (249x535) ¹	(2) 500MCM 5kV or 8kV/ sec. Winding	(2) 253mm ² 5kV or 8kV/sec. Winding	17.7 (449)
	PF7000	3300V/50Hz/RP18TX ⁷	46...430	70.9	9.79x21.06 (249x535) ¹	(2) 500MCM 8kV or 15kV/sec. Winding	(2) 253mm ² 8kV or 15kV/sec. Winding	17.7 (449)
	PF7000L	4160V/50Hz/RPDTD	375...575	70.71(L-A), 70.72 (L-L), 70.76 (LA), 70.77 (L-L), 70.89 (L-A), 70.94 (L-L)	11.22x23.62 (285x600) ¹	(4) 500MCM 5 kV or 8 kV/phase	(4) 253mm ² 5 kV or 8 kV/phase	18.0 (457)
	PF7000L	4160V/60Hz/RPDTD	375...625	70.71(L-A), 70.72 (L-L), 70.76 (LA), 70.77 (L-L)	11.22x23.62 (285x600) ¹	(4) 500MCM 5 kV or 8 kV/phase	(4) 253mm ² 5 kV or 8 kV/phase	18.0 (457)
	PF7000L	6600V/50Hz/RPDTD	325...575	70.80 (L-A), 70.85 (L-L), 70.86 (L-L), 70.87 (L-L), 70.88 (L-L), 70.91 (L-A), 70.92 (L-A), 70.93 (L-A)	11.22x23.62 (285x600) ¹	(4) 500MCM 8 kV or 15 kV/phase	(4) 253mm ² 5 kV or 8 kV/phase	18.0 (457)
	PF7000L	6600V/60Hz/RPDTD	325...575	70.80 (L-A), 70.85 (L-L), 70.86 (L-L), 70.87 (L-L), 70.88 (L-L), 70.91 (L-A), 70.92 (L-A), 70.93 (L-A), 70.93 (L-A)	11.22x23.62 (285x600) ¹	(4) 500MCM 8 kV or 15 kV/phase	(4) 253mm ² 5 kV or 8 kV/phase	18.0 (457)
	PF7000L	4160V/50Hz/R18TX	375...657	70.50 (L-A), 70.55 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 8 kV or 15 kV/s Winding	(2) 253mm ² 5 kV or 8 kV/s Winding	17.7 (449)
	PF7000L	4160V/60Hz/R18TX	375...657	70.50 (L-A), 70.55 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 8 kV or 15 kV/s Winding	(2) 253mm ² 5 kV or 8 kV/s Winding	17.7 (449)
	PF7000L	6600V/50Hz/R18TX	375...657	70.50 (L-A), 70.53 (L-A), 70.55 (L-L), 70.58 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 15 kV/s Winding	(2) 177mm ² 15 kV/s Winding	17.7 (449)
	PF7000L	6600V/60Hz/R18TX	375...657	70.50 (L-A), 70.53 (L-A), 70.55 (L-L), 70.58 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 15 kV/s Winding	(2) 177mm ² 15 kV/s Winding	17.7 (449)

Notes:

This data is informative only; do not base final design criteria solely on this data. Follow national and local installation codes, industry best practices, and cable manufacturer recommendations.

- Some 'A' Frames, most 'B' Frames, and all 'C' Frames have a single enclosure opening provision for both line and load cables (designated by ¹). Most 'A' Frames and some 'B' Frames have separate opening provisions for line and load cables. All cabling capacities shown in this table are "worst case" conditions when both line and load cabling enters and exits in the same direction.
- Cable sizes are based on overall dimensions of compact-stranded three-conductor shielded cable (common for industrial cable tray installations). Maximum sizing stated accounts for minimum rated cable insulation requirements and the next higher-rated cable (i.e., 8 kV is not commercially available in many areas of the world, therefore Rockwell Automation provides an 8 kV (minimum rating) as well as a 15 kV rating, when applicable. Enclosure openings will accommodate the thicker insulation on the higher-rated cable. IEC ratings show the equivalent to the NEMA sizes. The exact cable mm² size shown is not commercially available in many cases; use the next smaller standard size.
- Cable enters termination point horizontally in this case, therefore orient space for the stress cones horizontally also.
- Minimum cable bend radius recommendations vary by national codes, cable type, and cable size. Consult local codes for guidelines and requirements. General relationship of cable diameter to bend radius is typically between 7x...12x (e.g., if the cable diameter is 1 in. [2.54 cm] the minimum bend radius could range between 7...12 in. [18.8...30.48 cm]).
- For minimum cable insulation requirements, refer to the "PowerFlex 7000 Medium Voltage AC Drive User Manual" for your particular frame ('A', 'B', or 'C' Frame). Stated voltages are peak line-to-ground. Note: Some cable manufacturers rate cabling based on RMS line-to-line.
- Ground lug capabilities: 'A' Frame—two mechanical range lugs for ground cable connections; 'B', or 'C' Frame—up to ten mechanical range lugs for ground cable connections are available, typically these frames supply four. Mechanical range lugs can accommodate cable size #6-250MCM (13.3...127 mm²).
- 18 Pulse VFDs (R18TX) have nine line-side connections from the secondary isolation transformer windings entering the VFD. Lug pads are available for each connection. The lug pad and enclosure can generally accommodate two cables per connection, 18 cables in total (applies to all "B" and "C" configurations).
- Maximum cable size for "B" Frame (two per phase) and "C" Frame (four per phase) is 500 MCM (253 mm²), limited by lug pad assembly size and clearance requirements.
- As cabling methods can vary widely, maximum cable sizes shown do not account for the size of the conduit hub. Verify size of conduit hub(s) against the "Drive enclosure openings" shown.

Max. Load Cable Sizes

PRODUCT					OUTPUT (MOTOR SIDE)			
Bulletin		Description (V/Freq./Rect.)	Drive rating (A)	Drive Structure Code	Drive Enclosure Opening Inches (mm) ¹	Max. Size & No. Incoming Cables: NEMA 2-4-5-6-8-9	Max. Size & No. Incoming Cables: IEC 2-4-5-6-8-9	Vertical Space Avail. for Stress Cones Inches (mm)
'A' Frame (Air-Cooled)	PF7000A	2400V/60Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.4 (467)
	PF7000A	2400V/60Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	16.7 (424)
	PF7000A	3300V/50Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.4 (467)
	PF7000A	3300V/50Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	16.7 (424)
	PF7000A	4160V/50Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.4 (467)
	PF7000A	4160V/50Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	16.7 (424)
	PF7000A	4160V/60Hz/RPDTD	46...140	71.9 w/ starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	18.4 (467)
	PF7000A	4160V/60Hz/RPDTD	46...140	71.13, 71.18 w/o starter	4.00x4.00 (102x102)	(1) #4/0 5 kV or 8 kV/phase	(1) 107mm ² 5 kV or 8 kV/phase	16.7 (424)
	PF7000A	6600V/50Hz/RPDTD	40...93	71.10 w/ starter	4.00x4.00 (102x102)	(1) #4/0 8 kV or 15 kV/phase	(1) 107mm ² 8 kV or 15 kV/phase	18.4 (467)
	PF7000A	6600V/50Hz/RPDTD	40...93	71.14, 71.19 w/o starter	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	20.6 (524)
	PF7000A	2400V/60Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	33.8 (860)
	PF7000A	3300V/50Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	33.8 (860)
	PF7000A	4160/50Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	33.8 (860)
	PF7000A	4160/60Hz/RPTX	46...160	71.7	4.00x8.00 (102x204) ¹	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	33.8 (860)
	PF7000A	6600/50Hz/RPTX	40...105	71.8	4.00x8.00 (102x204) ¹	(1) 350MCM 15 kV/phase	(1) 177mm ² 15 kV/phase	33.8 (860)
	PF7000A	2400V/60Hz/RPTXI	46...160	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.6 (524) ³
	PF7000A	3300V/50Hz/RPTXI	46...160	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.6 (524) ³
	PF7000A	4160V/50Hz/RPTXI	46...140	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.6 (524) ³
	PF7000A	4160V/60Hz/RPTXI	46...160	71.3	4.00x4.00 (102x102)	(1) 350MCM 8 kV or 15 kV/phase	(1) 177mm ² 5 kV or 8 kV/phase	20.6 (524) ³
	PF7000A	6600V/50Hz/RPTXI	40...105	71.6, 71.15	4.00x4.00 (102x102)	(1) #4/0 8 kV or 15 kV/phase	(1) 177mm ² 8 kV or 15 kV/phase	20.6 (524) ³
'B' Frame (Air-Cooled)	PF7000	2400V/60Hz/RPDTD	46...430	70.40, 70.41, 70.44, 70.45	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	2400V/60Hz/RPDTD	46...375	70.40C, 70.41C, 70.44C w/ close-coupled starter	6.52x9.88 (168x251)	(1) 500MCM 5kV or 8kV/phase OR (2) 250MCM 5kV or 8kV/phase	(1) 253mm ² 5kV or 8kV/phase OR (2) 127mm ² 5kV or 8kV/phase	16.2 (411)
	PF7000	3300V/50Hz/RPDTD	46...430	70.43, 70.44, 70.45, 70.47	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	3300V/50Hz/RPDTD	E495-E625 G285, G325 N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.9 (430)

PRODUCT				OUTPUT (MOTOR SIDE)				
Bulletin		Description (V/Freq./Rect.)	Drive rating (A)	Drive Structure Code	Drive Enclosure Opening Inches (mm) ¹	Max. Size & No. Incoming Cables: NEMA 2-4-5-6-8-9	Max. Size & No. Incoming Cables: IEC 2-4-5-6-8-9	Vertical Space Avail. for Stress Cones Inches (mm)
'B' Frame (Air-Cooled) cont'd.	PF7000	3300V/50Hz/RPDTD	46...375	70.43C, 70.44C, 70.45C, 70.47C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV or 8kV/phase OR (2) 250MCM 5kV or 8kV/phase	(1) 253mm ² 5kV or 8kV/phase OR (2) 127mm ² 5kV or 8kV/phase	16.2 (411)
	PF7000	4160V/50Hz/RPDTD	46...375	70.43, 70.44, 70.45, 70.47	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	4160V/50Hz/RPDTD	46...375	70.43C, 70.44C, 70.45C, 70.47C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV or 8kV/phase OR (2) 250MCM 5kV or 8kV/phase	(1) 253mm ² 5kV or 8kV/phase OR (2) 127mm ² 5kV or 8kV/phase	16.2 (411)
	PF7000	4160V/60Hz/RPDTD	46...430	70.43, 70.44, 70.45, 70.47	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 8kV or 15kV/phase	28.5 (725)
	PF7000	4160/60Hz/RPDTD	E495-E625 G285, G325 N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.9 (430)
	PF7000	4160V/60Hz/RPDTD	46...375	70.43C, 70.44C, 70.45C, 70.47C w/close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV or 8kV/phase OR (2) 250MCM 5kV or 8kV/phase	(1) 253mm ² 5kV or 8kV/phase OR (2) 127mm ² 5kV or 8kV/phase	16.2 (411)
	PF7000	6600V/50Hz/RPDTD	46...285	70.46, 70.47, 70.48, 70.49	9.79x10.97 (249x279) ¹	(1) 500MCM 8kV/ phase	(1) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	6600V/50Hz/RPDTD	40...285	70.46C, 70.47C, 70.49C w/ close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV OR (2) 250MCM 8kV or 15kV/phase	(1) 253mm ² OR (2) 127mm ² 8kV or 15kV/phase	16.2 (411)
	PF7000	6600V/50Hz/RPDTD	E325-E575 G215, G250 N625	70.34, 70.35	12.79x19.68 (325x500) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 8kV or 15kV/phase	16.9 (430)
	PF7000	6600V/60Hz/RPDTD	40...285	70.46, 70.47, 70.48, 70.49	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	6600V/60Hz/RPDTD	40...285	70.46C, 70.47C, 70.49C w/ close-coupled starter	5.61x7.19 (142x183)	(1) 500MCM 5kV OR (2) 250MCM 8kV or 15kV/phase	(1) 253mm ² OR (2) 127mm ² 8kV or 15kV/phase	16.2 (411)
	PF7000	2400V/60Hz/RPTX	46...430	70.1, 70.2, 70.25, 70.26	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	3300V/50Hz/RPTX	46...430	70.10, 70.27, 70.28, 70.30	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	3300V/50Hz/RPTX	E495-E625 G285, G325 N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.9 (430)
	PF7000	4160V/50Hz/RPTX	46...430	70.10, 70.27, 70.29, 70.30	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	4160V/60Hz/RPTX	46...430	70.2, 70.26, 70.27, 70.28, 70.29, 70.31	9.79x10.97 (249x279) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	28.5 (725)
	PF7000	4160V/60Hz/RPTX	E495-E625 G285, G325 N720	70.32	11.81x16.22 (300x412) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.9 (430)
	PF7000	6600V/50Hz/RPTX	40...285	70.11, 70.28, 70.30, 70.31	9.79x10.97 (249x279) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 8kV or 15kV/phase	28.5 (725)
	PF7000	6600V/50Hz/RPTX	E325-E575 G215, G250 N625	70.36, 70.37	12.79x19.68 (325x500) ¹	(2) 500MCM 8kV or 15kV/phase	(2) 253mm ² 8kV or 15kV/phase	16.9 (430)

PRODUCT					OUTPUT (MOTOR SIDE)			
Bulletin		Description (V/Freq./Rect.)	Drive rating (A)	Drive Structure Code	Drive Enclosure Opening Inches (mm) ¹	Max. Size & No. Incoming Cables: NEMA 2-4-5-6-8-9	Max. Size & No. Incoming Cables: IEC 2-4-5-6-8-9	Vertical Space Avail. for Stress Cones Inches (mm)
'C' Frame (Liquid-Cooled)	PF7000	2400V/60Hz/RP18TX ⁷	46...430	70.8	9.79x21.06 (249x535) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.4 (415)
	PF7000	3300V/50Hz/RP18TX ⁷	46...430	70.9	9.79x21.06 (249x535) ¹	(2) 500MCM 5kV or 8kV/phase	(2) 253mm ² 5kV or 8kV/phase	16.4 (415)
	PF7000L	4160V/50Hz/RPDTD	375...575	70.71(L-A), 70.72 (L-L), 70.76 (LA), 70.77 (L-L), 70.89 (L-A), 70.94 (L-L)	11.22x23.62 (285x600) ¹	(4) 500MCM 5 kV or 8 kV/phase	(4) 253mm ² 5 kV or 8 kV/phase	16.4 (415)
	PF7000L	4160V/60Hz/RPDTD	375...625	70.71(L-A), 70.72 (L-L), 70.76 (LA), 70.77 (L-L)	11.22x23.62 (285x600) ¹	(4) 500MCM 5 kV or 8 kV/phase	(4) 253mm ² 5 kV or 8 kV/phase	16.4 (415)
	PF7000L	6600V/50Hz/RPDTD	325...575	70.80 (L-A), 70.85 (L-L), 70.86 (L-L), 70.87 (L-L), 70.88 (L-L), 70.91 (L-A), 70.92 (L-A), 70.93 (L-A)	11.22x23.62 (285x600) ¹	(4) 500MCM 8 kV or 15 kV/phase	(4) 253mm ² 8 kV or 15 kV/phase	16.4 (415)
	PF7000L	6600V/60Hz/RPDTD	325...575	70.80 (L-A), 70.85 (L-L), 70.86 (L-L), 70.87 (L-L), 70.88 (L-L), 70.91 (L-A), 70.92 (L-A), 70.93 (L-A)	11.22x23.62 (285x600) ¹	(4) 500MCM 8 kV or 15 kV/phase	(4) 253mm ² 8 kV or 15 kV/phase	16.4 (415)
	PF7000L	4160V/50Hz/R18TX	375...657	70.50 (L-A), 70.55 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 5 kV or 8V/phase	(2) 253mm ² 5 kV or 8 kV/phase	16.4 (415)
	PF7000L	4160V/60Hz/R18TX	375...657	70.50 (L-A), 70.55 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 5 kV or 8V/phase	(2) 253mm ² 5 kV or 8 kV/phase	16.4 (415)
	PF7000L	6600V/50Hz/R18TX	375...657	70.50 (L-A), 70.53 (L-A), 70.55 (L-L), 70.58 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 8 kV or 15 kV/phase	(2) 253mm ² 8 kV or 15 kV/phase	16.4 (415)
	PF7000L	6600V/60Hz/R18TX	375...657	70.50 (L-A), 70.53 (L-A), 70.55 (L-L), 70.58 (L-L)	9.79x21.06 (249x535) ¹	(2) 500MCM 8 kV or 15 kV/phase	(2) 253mm ² 8 kV or 15 kV/phase	16.4 (415)

Notes:

This data is informative only; do not base final design criteria solely on this data. Follow national and local installation codes, industry best practices, and cable manufacturer recommendations.

- Some 'A' Frames, most 'B' Frames, and all 'C' Frames have a single enclosure opening provision for both line and load cables (designated by ¹). Most 'A' Frames and some 'B' Frames have separate opening provisions for line and load cables. All cabling capacities shown in this table are "worst case" conditions when both line and load cabling enters and exits in the same direction.
- Cable sizes are based on overall dimensions of compact-stranded three-conductor shielded cable (common for industrial cable tray installations). Maximum sizing stated accounts for minimum rated cable insulation requirements and the next higher-rated cable (i.e., 8 kV is not commercially available in many areas of the world, therefore Rockwell Automation provides an 8 kV (minimum rating) as well as a 15 kV rating, when applicable. Enclosure openings will accommodate the thicker insulation on the higher-rated cable. IEC ratings show the equivalent to the NEMA sizes. The exact cable mm² size shown is not commercially available in many cases; use the next smaller standard size.
- Cable enters termination point horizontally in this case, therefore orient space for the stress cones horizontally also.
- Minimum cable bend radius recommendations vary by national codes, cable type, and cable size. Consult local codes for guidelines and requirements. General relationship of cable diameter to bend radius is typically between 7x...12x (e.g., if the cable diameter is 1 in. [2.54 cm] the minimum bend radius could range between 7...12 in. [18.8...30.48 cm]).
- For minimum cable insulation requirements, refer to the "PowerFlex 7000 Medium Voltage AC Drive User Manual" for your particular frame ('A', 'B', or 'C' Frame). Stated voltages are peak line-to-ground. Note: Some cable manufacturers rate cabling based on RMS line-to-line.
- Ground lug capabilities: 'A' Frame—two mechanical range lugs for ground cable connections; 'B', or 'C' Frame—up to ten mechanical range lugs for ground cable connections are available, typically these frames supply four. Mechanical range lugs can accommodate cable size #6-250MCM (13.3...127 mm²).
- 18 Pulse VFDs (R18TX) have nine line-side connections from the secondary isolation transformer windings entering the VFD. Lug pads are available for each connection. The lug pad and enclosure can generally accommodate two cables per connection, 18 cables in total (applies to all "B" and "C" configurations).
- Maximum cable size for "B" Frame (two per phase) and 'C' Frame (four per phase) is 500 MCM (253 mm²), limited by lug pad assembly size and clearance requirements.
- As cabling methods can vary widely, maximum cable sizes shown do not account for the size of the conduit hub. Verify size of conduit hub(s) against the "Drive enclosure openings" shown.

Specifications



ATTENTION: In the event of discrepancies between information published in generic manual specifications and those included with your specific design or electrical drawings, take the DD or EE ratings as correct values.

Specifications

Table 16 - General Design Specifications

Description	
Motor Type	Induction or Synchronous
Input Voltage Rating	2400V, 3300V, 4160V, 6600V
Input Voltage Tolerance	± 10% of Nominal
Voltage Sag ⁽¹⁾	-30%
Control Power Loss Ride-through	5 Cycles (Std) > 5 Cycles (Optional UPS)
Input Protection ⁽²⁾	Surge Arrestors (AFE/Direct-to-Drive) Metal Oxide Varistor (MOV) (18 Pulse)
Input Frequency	50/60 Hz, +/- 0.2%
Power Bus Input Short-circuit Current Withstand (2400...6600V ⁽³⁾)	25 kA RMS SYM, 5 Cycle
Basic Impulse Level ⁽⁴⁾	45 kV (0...1000 m)
Power Bus Design	Copper - Tin plated
Ground Bus	Copper - Tin plated 6 x 51 mm (¼ x 2 in.)
Customer Control Wire Way	Separate and Isolated
Input Power Circuit Protection ⁽⁵⁾	Vacuum Contactor with Fused Isolating Switch or Circuit Breaker
Output Voltage	0...2400V 0...3300V 0...4160V 0...6000V, 0...6300V, 0...6600V
Inverter Design	PWM
Inverter Switch	SGCT
Inverter Switch Failure Mode	Non-rupture, Non-arc
Inverter Switch Failure Rate (FIT)	100 per 1 Billion Hours Operation
Inverter Switch Cooling	Double Sided, Low Thermal Stress
Inverter Switching Frequency	420...440 Hz

Table 16 - General Design Specifications (Continued)

Description			
Number of Inverter SGCTs	Voltage	SGCTs (per phase)	
	2400V	2	
	3300V	4	
	4160V	4	
	6600V	6	
Inverter PIV Rating (Peak Inverse Voltage)	Voltage	PIV (each device)	Total PIV
	2400V	6500V	6500V
	3300V	6500V	13,000V
	4160V	6500V	13,000V
	6600V	6500V	19,500V
Rectifier Designs	Direct-to-Drive (transformerless AFE rectifier) AFE with separate isolation transformer 18 Pulse with separate isolation transformer		
Rectifier Switch	SCR (18 Pulse), SGCT (AFE Rectifier)		
Rectifier Switch Failure Mode	Non-rupture, Non-arc		
Rectifier Switch Failure Rate (FIT)	50 (SGCT) 100 (SCR) per 1 Billion Hours Operation		
Rectifier Switch Cooling	Double Sided, Low Thermal Stress		
Number of Rectifier Devices per phase	Voltage	AFE	18 Pulse
	2400V	2	6
	3300V	4	6
	4160V	4	6
	6600V	6	6
Output Current THD (1 st ...49 th)	< 5%		
Output Waveform to Motor	Sinusoidal Current / Voltage		
Medium Voltage Isolation	Fiber Optic		
Modulation techniques	Selective Harmonic Elimination (SHE) Synchronous Trapezoidal PWM Asynchronous or Synchronous SVM (Space Vector Modulation)		
Control Method	Digital Sensorless Direct Vector Full Vector Control with Encoder Feedback (Optional)		
Tuning Method	Auto Tuning via Setup Wizard		
Speed Regulator Bandwidth	1...10 rad/s with standard control 1...20 rad/s with HPTC (optional)		
Torque Regulator Bandwidth	15...50 rad/s with standard control 80...100 rad/s with HPTC (optional)		
Torque Accuracy with HPTC (optional)	+/- 5%		
Speed Regulation	0.1% without Encoder Feedback 0.01...0.02% with Encoder Feedback		
Acceleration/Deceleration Range	Independent Accel/Decel – 4 x 30 s		
Acceleration/Deceleration Ramp Rates	4 x Independent Accel/Decel		
S Ramp Rate	Independent Accel/Decel – 2 x 999 s		
Critical Speed Avoidance	3 x Independent with Adjustable bandwidth		
Stall Protection	Adjustable time delay		

Table 16 - General Design Specifications (Continued)

Description		
Load Loss Detection	Adjustable level, delay, speed set points	
Control Mode	Speed or Torque	
Current Limit	Adjustable in Motoring and Regenerative	
Output Frequency Range	0.2...75 Hz (Standard) 75 Hz...85Hz (Optional - need specific Motor Filter Capacitor [MFC])	
Service Duty Rating	Normal Duty	Heavy Duty
	110% Overload for 1 min. every 10 min. (Variable Torque Load)	150% Overload for 1 min. every 10 min. (Constant Torque Load)
Typical VFD Efficiency	> 97.5% (AFE) > 98% (18 Pulse) Contact Factory for Guaranteed Efficiency of Specific Drive Rating	
Input Power Factor	AFE Rectifier	
	0.95 minimum, 10...100% Load	
IEEE 519 Harmonic Guidelines ⁽⁶⁾	IEEE 519 - 1992 Compliant	
VFD Noise Level	< 85 dB (A) per OSHA Standard 3074	
Regenerative Braking Capability	Inherent – No Additional Hardware or Software Required	
Flying Start Capability	Yes – Able to Start into and Control a Spinning Load in Forward or Reverse Direction	
Operator Interface	10" Color Touchscreen – Cat# 2711P-T10C4A9 (VAC) Built-in PDF viewer Redesigned PanelView Plus 6 Logic Module with 512 Mb of memory	
Languages	English, French, Spanish, Portuguese, German, Chinese, Italian, Russian, and Polish	
Control Power	220/240V or 110/120V, Single phase - 50/60 Hz (20 A)	
External I/O	16 Digital Inputs, 16 Digital Outputs	
External Input Ratings	50...60 Hz AC or DC 120...240V – 1 mA	
External Output Ratings	50...60 Hz AC or DC 30...260V – 1 A	
Analog Inputs	Three Isolated, 4...20 mA or 0...10V (250 Ω)	
Analog Resolution	Analog input 12 Bit (4...20 mA) Internal parameter 32 Bit resolution Serial Communication 16 Bit resolution (.1Hz) (Digital Speed Reference)	
Analog Outputs	One Isolated, Eight Non-isolated, 4...20 mA or 0...10V (600 Ω)	
Communication Interface	Ethernet IP/DPI	
Scan Time	Internal DPI – 2 ms min., 4 ms max.	

Table 16 - General Design Specifications (Continued)

Description		
Communications Protocols (Optional)	DeviceNet	ControlNet
	Ethernet I/P	Lon Works
	Dual-port Ethernet I/P	Can Open
	Profibus	RS485 HVAC
	Modbus	RS485 DF1
	Interbus	RS232 DF1
	USB	
Enclosure	NEMA 1 (standard)	IP21 (IEC)
	NEMA 12 (optional)	IP42 (IEC)
Lifting Device	Standard / Removable	
Mounting Arrangement	Mounting Sill Channels	
Structure Finish	Epoxy Powder – Paint Exterior Sandtex Light Grey (RAL 7038) – Black (RAL 8022) Internal – Control Sub Plates – High Gloss White (RAL 9003)	
Interlocking	Key provision for customer input Disconnecting Device	
Corrosion Protection	Unpainted Parts (Zinc Plated / Bronze Chromate)	
Ambient Temperature	0...40 °C (32...104 °F) / 0...50 °C (32...122 °F) - optional	
Fiber Optic Interface	Rectifier – Inverter – Cabinet (Warning / Trip)	
Door Filter	Painted Defuser with Matted Filter Media	
Door Filter Blockage	Air Flow Restriction Trip / Warning	
Storage and Transportation Temperature Range	-40...70 °C (-40...185 °F)	
Relative Humidity	Max. 95%, non-condensing	
Altitude (Standard)	0...1000 m (0...3300 ft)	
Altitude (Optional)	1001...5000 m (0...16,400 ft)	
Seismic (UBC Rating)	1, 2, 3, 4	
Standards	NEMA, IEC, CSA, UL, ANSI, IEEE	

(1) Voltage Sag tolerance is reduced to -25% when control power is supplied from medium voltage via CPT.

(2) MOVs are used for 18 Pulse. Surge arrestors are used for AFE/Direct-to-Drive configurations.

(3) Short-circuit fault rating based on input protection device (contactor or circuit breaker).

(4) BIL rating based on altitudes < 1000 m (3300 ft) Refer to factory for derating on altitudes > 1000 m.

(5) Optional.

(6) Under certain conditions, power system analysis will be required.

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